

CRANFIELD UNIVERSITY

TOBIAS WIDMER

Sustainable Customer Solutions

An Institutional Theory Approach to Link Resource Integration and Value
Creation

SCHOOL OF MANAGEMENT
PhD in Leadership and Management

Doctor of Philosophy
Academic Year: 2016-2023

Supervisor: Professor Michael Bourlakis
Associate Supervisor: Dr Daniel Prior and Professor Emel Aktas
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degree of Doctor of Philosophy

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ABSTRACT

Alternatives to current resource intensive ways of production and consumption are required to achieve the UN Sustainable Development Goals. Transitioning from product sales to providing customer solutions (CS) has the potential to enhance sustainability.

This transition, however, leads to managerial complexity, which increases further when trying to simultaneously become more sustainable. To succeed, manufacturers must ensure that their customers create economic, social, and environmental value with the CS. However, pursuing multiple goals may lead to tensions or require trade-offs.

Informed by literature from Institutional Theory, industrial marketing, and sustainability, two studies were conducted. First, a multiple-case study investigated under which conditions resource integration (RI) is sustainable. By using ideal type logics, the study identified practices, values, and beliefs of business logics, as well as occurrences of conflicting, competing, and compatible logics which must be navigated collaboratively with customers to overcome barriers. Second, a single-case study investigated how RI translates into customers achieving their economic, social, and environmental goals. The study identified resources, value proposition components, and value-in-use constructs which were used in a means-end chain analysis, identifying multiple internal and external enablers and catalysts to stewardship practice in CS.

The study found that CS can enhance sustainability compared to product sales, though it is not inherently guaranteed. The development of value propositions (VP) in CS is triggered internally or through the customers. Customers' goals and the assessment thereof are continuously changing, requiring the VP to be dynamic and adapting by introducing and removing resources. A proposed framework of a value creation cycle establishes stewardship practice as a means to empirically explore and theoretically explain value creation in sustainable CS with institutional arrangements that manifest at multiple levels of a service-ecosystem. Along the value creation cycle, novel operational and cultural enablers and catalysts as well as challenges were identified, and are added to the body of knowledge which helps managers understand the requirements for successfully developing and implementing sustainable CS.

Keywords: Value proposition development, stewardship practice, circular economy

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LIST OF ABBREVIATIONS

RI	Resource integration
ML	Market logic
PL	Production logic
CS	Customer solution
ViU	Value-in-use
CE	Circular economy
CSR	Corporate social responsibility
EPR	Extended producer responsibility
BoL	Beginning of life
MoL	Mid of life
EoL	End of life
TCO	Total cost of ownership

1 INTRODUCTION

1.1 Research Background

Increasing industrialisation and its associated material consumption and waste generation are causing irreversible effects on the global environment and impacting climate, biodiversity, and ecosystem functions. There is little dispute that the current resource-intensive methods of production and consumption are not sustainable in ensuring economic prosperity while preserving, protecting, and restoring environmental quality and promoting social equality. The growing population, increase in poverty, and inequality associated with globalisation demand the development of new sustainability visions (Hart and Milstein, 2003).

On a global level, the United Nations General Assembly adopted the resolution *Transforming our world: the 2030 Agenda for Sustainable Development*, widely known as the sustainable development goals or short SDG (United Nations, 2015). These goals ensure the health of the earth as a global plan of action for people, planet, prosperity, and peace. The civil society is increasingly well-connected through technology and challenges organisations to be more transparent and taking on a stewardship role in their business operations and products. This in turn may lead to a better reputation and legitimacy of the firm (Hart and Milstein, 2003). Businesses organise in leadership platforms, such as United Nations Global Compact, the largest corporate sustainability initiative in the world, to ‘align their operations and strategies with principles in the areas of human rights, labour, environment and anti-corruption, and to take action in support of UN goals and issues (UN Global Compact, 2018).

Besides the reputational benefit for organisations, proactive resource efficiency and pollution prevention can help to decouple economic growth from resource consumption. Rather than being reactive and corrective (Geissdoerfer et al., 2017), novel proactive approaches to sustainability may lead to cost and risk reductions. These are supported by new and emerging disruptive technologies which may make current revenue streams of material-intensive industries obsolete (Hart and Milstein, 2003). These approaches aim

to create value in multiple ways. They are improving systemic resource efficiency and circulation of materials by closing resource loops by recycling or reusing discarded materials or waste back into circulation, narrowing resource flows by reducing the amount of resources needed for a given operation, and slowing resource flows by extending the lifecycle or usage period of specific resources (Ranta et al., 2019).

Research shows that excellent companies are distinguished from other companies by their ethical values, and not merely by logical cognitive assessments of value-for-money outcomes (Edvardsson and Enquist, 2011). Ethical values can increase environmental sustainability in operations, improve customer relation, and may increase market performance (Vesal et al., 2020). Sustainable enterprises contribute to sustainable development by delivering simultaneously economic, social, and environmental benefits (Hart and Milstein, 2003). They seek to better balance value creation for all stakeholders to eliminate conflicting demands and negative outcomes for any of the stakeholders (Bocken et al., 2013). The value created needs to be viewed in a holistic systems thinking approach that represents different forms comprising (Evans et al., 2017):

- Economic value forms: profit, return on investment, financial resilience, long-term viability, and business stability.
- Social value forms: Equality and diversity, well-being, community development, secure livelihood, labour standards, health, and safety.
- Environmental value forms: Renewable resources, low emissions, low waste, biodiversity, and pollution prevention.

Extant research suggests that manufacturing companies can strengthen their stewardship role and create sustainable value with changes in their business models and value propositions with a shift from selling products to offering services (Tukker, 2004). This research is concerned with two fundamental changes. The first is a shift from selling products to providing customised solutions which combine products with services (Rabetino et al., 2018). The second shift is the shift from wasteful and resource intensive ways of production and consumption to a sustainable and resource efficient way of doing business in which these manufacturers increase their stewardship practice (BSI, 2017; Geissdoerfer et al., 2017; Murray et al., 2017).

1.1.1 A Shift from Product Sales to Customer Solutions

Solution businesses are a type of business model in the business-to-business environment. Business models describe a company's market strategy, that describes how satisfying a customer's need leads to competitive advantage (Casadesus-Masanell and Ricart, 2010). The strategy of solutions businesses is that companies combine processes, goods, and services to jointly address the customer's operational and business needs and create more benefits than each of the elements separately (Uлага and Reinartz, 2011). Solution businesses have in common that they are traditionally designed or customised to address a customer's particular needs and being integrated with other goods and services (Tuli et al., 2007).

The value proposition defines how a company's items of value are packed and offered to fulfil a customer's need through bundling products, services and complementary value-added services for a particular customer segment, based on several resources and capabilities (Osterwalder and Pigneur, 2003). The integration and marketing of value propositions that comprise products and services are typically referred to as customer solutions (CS) and are the focus of this research. These CS are provided by manufacturing heavy companies, who process raw materials and/or parts into finished goods.

Research in the field of CS emphasises on value co-creation with customers, alongside related topics such as value-in-use (ViU), ownership, and pricing models. The core debates also include the design of encounter mechanisms for involving customers in value co-creation (Rabetino et al., 2018). The transformation from a product sales business to a CS requires a change in the firm's market logic (ML) from one that emphasises on the product to one that emphasises on the service a solution provides. Servitization describes a manufacturing company's transition from a product sales business with a product ML to becoming a solution provider with a service ML (Baines et al., 2009; Oliva and Kallenberg, 2003). With such a service ML, the manufacturer not only ensures mere operational efficiency to a passive customer but actively engages with the customer and makes customer involvement a major part of the business model (Green et al., 2017).

Extant research suggests the potential for stewardship practice in CS by delivering functionality rather than the ownership over a product as one of the key pillars and archetypical sustainable business model (Bocken et al., 2014; Evans et al., 2017; Lüdeke-Freund et al., 2018). Assets in a CS such as machines or equipment may be exploited more efficiently through access-based models and manufacturers may be incentivised to consider the total cost of ownership (TCO) over the different lifecycle stages of products, including the planning of recovery strategies at the end of life (Bocken et al., 2014). Life cycle thinking incentivises a manufacturer to develop products that last longer and prolong the lifetime of products by designing them for upgradability, reparability, and potentially reducing resource consumption throughout the product's life cycle. Most importantly, selling a service rather than a good breaks the link between financial profit and production volume (Bocken et al., 2014).

1.1.2 A Shift from Traditional to Sustainable Production

Policies such as the ban on single-use plastics along with statements like 'by 2050 there will be more plastic than fish in the ocean' (Ellen MacArthur Foundation, 2016) and pictures of flora and fauna suffocating under mountains of plastic waste mobilise individuals and governments alike. Companies are increasingly challenged by the public opinion and at risk of scrutiny as technology enables more transparent supply chains and misconduct can become 'viral' with one click if they are not taking on a stewardship role (Widmer and Prior, 2019). So, organisations have to adapt to what they believe society expects from them (Boxenbaum and Jonsson, 2017), making a strong positive reputation and image is an important source of competitive advantage factor for virtually all major organisations. As a result, it is crucial for companies to practise stewardship and follow the trend of sustainability for two reasons. First, to avoid losing access to the best human capital in the market as employees in their choice for employers seek companies with a sustainability aligned reputation. Second, investors may divest in case a firm fails to show positive environmental and social metrics of sustainably and sound sustainable business strategies (Rattalino, 2018).

Practising stewardship as a proactive approach to sustainability is about accountability for the direct and indirect impacts of decisions and activities within a wider system and might be shared or wholly owned by an individual, organisation, or community. When practising stewardship, organisations genuinely and proactively engage with all stakeholders, including the natural environment, to ensure their long-term health and well-being thereof. Stewardship considerations take place across the value chain, including what happens upstream in the supply chain and downstream with the customers, taking into account economic, environmental and social issues both now and those projected into the future (Bocken et al., 2014; BSI, 2017; Ehrenfeld, 2000).

In product development, the origin of raw materials in the supply chain must be considered. Organisations should consider environmental and social impacts from upstream processing and acquisition of raw materials, and not overexploit the natural capital. These considerations must be continued through to downstream issues associated with the management of end of life of products (Bocken et al., 2014; BSI, 2017).

The idea of a circular economy (CE) discusses different strategies and business models for the extension of resource-life (Blomsma and Brennan, 2017) and gains attention as a means to achieve sustainable development goals such as responsible consumption and production and decoupling economic growth from resource consumption (Geissdoerfer et al., 2017). Circular economy is an antonym of a linear economy, the traditional production systems which convert natural resources into waste via production, deplete natural capital and virgin resources, and reduce natural capital through waste and pollution (Murray et al., 2017). In a sense, the linear traditional production logic PL describes the way of how 20th-century economics worked and contrasts circular approaches for the days ahead with a sustainable PL.

1.2 Research Problem

Becoming more sustainable is important. However, the industry reality is that costs, managerial complexity, and insufficient pressure for leaving successful practices are major impediments to sustainable development activities. Often, neither the customer is willing to pay more for a sustainable alternative nor is the manufacturer willing to invest in sustainable alternatives. Therefore it is important to offer CS which are both more environmentally sustainable and create economic value for customers. Successful servitization, as well as increasing stewardship, is not only an operational change but as well a cultural shift in the values, beliefs, and practices of manufacturing firms, described as a change in the institutional logics of an organisation (Edvardsson et al., 2011). Changing the PL and ML are both challenges on their own. The change requires companies to stepwise change their business models, pilot them, and increasingly implement new offerings.

Conceptually, the case for sustainable CS is comprehensible as both a sustainable PL and a service ML are interested in reducing the use of physical resources. However, they do so for different reasons. Extant research has confirmed that solution businesses can be more sustainable than pure product sales, but little empirical evidence of established industrial businesses increasing sustainability with CS exists. Early literature was predominantly focussed on consumer goods and the equipment was mostly of low technological complexity, such as power tools, garden equipment, and baby prams (Mont et al., 2006) or flooring solutions (Chou et al., 2015). The tension between sustainability and commercial success presents a multifaceted and interesting research problem.

Lincoln and Guba (1985) defined a research problem as threefold, being a state of affairs that (1) identifies the need for choosing between alternative courses of action, (2) leads to undesirable consequences, (3) and begs for additional understanding. These three all apply to the current understanding of sustainable CS.

The current state requires choosing between alternative courses of action:

An organisation is exposed to multiple logics during a transition phase. This plurality of logics can lead to managerial complexity which may resolve or continue beyond the formal transition phase (Greenwood et al., 2011; Santos and Pache, 2010). In the context of sustainable CS, these logics are product ML and service ML while servitizing, and traditional PL and sustainable PL to become more sustainable in the RI.

Manufacturers inform their decision-making with PL and ML which mutually influence each other. A possible explanation for the challenges of developing sustainable CS lies in the complexity while undergoing a stepwise change, which requires the managers to choose between multiple courses of action when servitizing and is observable in the process of RI (Haffar and Searcy, 2017). For example, a company would have an established profitable business unit with less sustainable products that focus on sales, and a new line that is built around the outcome and allows product recovery. Eventually, this manufacturer's managers will come into situations where they must make trade-offs and choose either service ML or sustainable PL as pursuing sustainable PL may be too risky or costly. Therefore, choose between different courses of actions of which some may be not in favour of the environment.

The current state can lead to undesirable consequences:

Research on the topic of servitization started over thirty years ago (Vandermerwe and Rada, 1988) with the dominant focus of creating a competitive advantage for manufacturing firms. The idea of substituting natural resources with labour is not novel (Stahel, 1984). The broader academic and public interest in CS as sustainable alternatives to product sales, however, is a rather recent development (Tukker, 2004). Given the roots of servitization and CS in competitive advantage suggests that most of the extant knowledge in the field does not consider environmental sustainability and servitization in fact may have a negative environmental impact.

Since the advent of CE in the early 2010' the idea that service is a go-to strategy for managers to become more sustainable circulates in academic and practitioner literature. This view is, however, often oversimplified as the challenges for servitizing companies

are multifaceted and stem from different sources. One reason for this claim is that existing studies are often not explicit about what the driver for servitizing is. An assumption is, that in many cases the environmental benefits were not the driver in changing the business model, but an afterthought and welcomed side effect from seeking business growth.

A manufacturer responding to the tensions in the ML by servitizing will eventually not just resolve the ML, but as well resolve or create tensions in the production logic. Tensions in PL mean that operational activities that are required to servitize lead to negative environmental outcomes. However, the lack of accessible cases for sustainable CS and the fact that extant research is predominantly conceptual (Blomsma and Brennan, 2017; Bocken et al., 2014; Kirchherr et al., 2017) poses a challenge to managers who are interested in making their business more sustainable.

The current state begs for additional understanding:

We know from extant literature in the domain of solution businesses that ‘value’ lies in the customer perception and use, rather than in the materials involved in servitized goods. Actors in solution businesses constantly design and combine processes, goods, and services in a service-ecosystem while integrating and exchanging resources (Vargo and Lusch, 2016) to jointly address the customer’s particular operational and business needs with the CS (Tuli et al., 2007; Ulaga and Reinartz, 2011). Actors may seek support from institutional norms and logics within their service system (Edvardsson et al., 2014) to assess whether their value propositions are valuable in a specific context and help customers achieve their goals (Macdonald et al., 2016), highlighting the relevance of institutional context (Vargo and Lusch, 2016) and reflecting the fact, that value is interactive, relativistic, and meaning-laden in a given context (Edvardsson et al., 2011).

An organisation’s environment coordinates the goal setting at a macro level (Vargo and Lusch, 2016) and resource integration (RI) at a micro level (Edvardsson et al., 2014). The economic value of CS has been widely researched, but there is a need for a better understanding of what ‘value’ in the context of sustainable CS means. Empirical work linking sustainable resource integration and the creation of sustainable value is in an early stage.

1.3 Research Aim

There are multiple changes currently occurring in the way how manufacturing companies do business. On the one hand, the emergence of ideas such as the CE leads to a change in the production logic, on the other hand, the more service-oriented ML promises to deliver more value to the customer. The purpose of a research inquiry, according to Lincoln and Guba (1985), is to resolve the research problem by accumulating sufficient knowledge which leads to understanding the explanation through some kind of synthesis.

In Subsection 1.2 the research problem was defined as a threefold state of affairs that identifies the need for choosing between alternative courses of action, leads to undesirable consequences, and begs for additional understanding. For this research, this means that:

- Managers must choose between traditional and sustainable PL when servitizing.
- Servitization can lead to negative environmental outcomes if a sustainable PL is not actively pursued.
- The creation of economic value in CS is well understood, but the creation of sustainable value begs for additional understanding.

In line with this definition of the research problem, the aim of the research is to better understand the theoretical and managerial aspects of how resource integration in sustainable customer solutions lead to customer value. This aim implies that at least two subsequent prerequisites for sustainable CS exist. First, the RI must be sustainable, to ensure that the servitization is sustainable and does not lead to unwanted negative environmental impacts. Second, not only economic but sustainable value must be created for the customer in the CS. These two prerequisites are formulated as research questions in Section 2.6.4.

The research addresses the need to expand the knowledge of sustainable CS. This knowledge can help managers involved in the development of CS such as marketers, product developers, business developers, and heads of business units which must sense the firm's ever-changing environment and explore how they can increase stewardship practice in their company's RI. These managers are engaged in the tasks and processes concerning the analytical preparation of potential growth opportunities, and the support

and monitoring of the implementation of growth opportunities (Sørensen, 2012). They may as well be concerned with one of the objectives of a CE, that is to decouple economic growth and production from the dependence on natural resources (Esposito et al., 2017).

Considering the potential conflicts of the two objectives, ‘preparing growth opportunities’ and ‘decoupling economic growth’, this research is expected to be helpful for both academics and professionals to develop and realise stewardship-informed CS to sustain a company’s success and economic prosperity while maintaining, protecting, and restoring environmental quality, and guaranteeing social equality.

Table 1-1 presents the twelve subsequent steps in which the research was conducted.

1.4 Contributions

This research unveils the transformative potential inherent in industries through institutional stewardship practices. It contributes to Institutional Theory by integrating ideal types and institutional pluralism, offering insights into the dynamics of conflicting, competing, and compatible logics within the ecosystem. Within these ecosystems, institutional arrangements manifest at multiple levels in the service ecosystem and with. The study discovers that CE is a hybrid logic with field level resource integration practice that manifest at multiple levels of aggregations in the service-ecosystem. This bridges the divide between engineering-focused studies and social sciences, affirming its scholarly relevance. The study provides understanding of value creation mechanisms in SB by introducing a dynamic means-end chain approach that transcends conventional linear processes. It introduces a precise value hierarchy, providing a methodological scaffold for comprehending the interplay of resources, value propositions, and Value-in-Use constructs.

This study yields managerial implications to develop sustainable SB. Managers in today's dynamic business landscape must weave environmental sustainability objectives into their resource integration practices, particularly when embracing servitization as a core business strategy. This strategic shift necessitates a careful balance between economic growth and responsible resource consumption, calling for an adept approach to value

creation. Developing customer-centric value propositions demands an iterative process, requiring constant adjustment of the resources integrated. Challenges faced by managers span a spectrum, encompassing both internal and external factors, as well as means and ends. In navigating this complex terrain, managers can draw upon a diverse array of internal and external drivers that serve as powerful enablers and catalysts for sustainable solution businesses. These drivers are rooted in a blend of coercive, normative, and mimetic pressures, providing valuable guidance in the pursuit of environmentally responsible practices.

Policy recommendations are instrumental in propelling the transition towards a more sustainable and circular economy. To facilitate this shift, the study found that regulatory frameworks should adopt a more permissive stance towards second-life applications and end of life scenarios. Offering tax incentives for activities like repairing, remanufacturing, and utilizing secondary resources is imperative for expediting the circular economy's advancement. Furthermore, harnessing the power of public procurement can serve as a dynamic driver for sustainable innovation. Close collaboration between governments and regulatory bodies with industry associations is paramount. This synergy ensures that policies and industry norms align harmoniously, creating a conducive environment for the widespread adoption of circular practices across various sectors. Such coordinated efforts are essential for steering economies towards a more ecologically conscious and economically efficient future.

Table 1-1: Research phases

Phase Nr	Timeline	Activities	Framework components
Phase 1	Positioning Study Nov 2016 – Feb 2017	Mark the field for the research including value, circular economy, and product-service systems	Business models and value, service-dominant logic, value for different stakeholders, trade-offs for the stakeholders
Phase 2	Systematic literature reviews Feb 2017 – Oct 2017	Develop an understanding for value in outcome-based solution business and circular economy principles	Supply chain networks in solution business, life cycles of assets, favouring conditions, value manifestations, circular economy principles
Phase 3	Framework development Nov 2017- Dec 2019	Develop an initial framework from the literature	An initial a priori framework was developed that covered sustainable production logic, customer value, Resource integration, Practice Theory, and Evaluating value
Phase 4	Developing sample and initiating data collection Jan 2019 -Jun 2019	Develop sample, Engage companies, first 9 interviews	The initial assumptions were tested to see if the framework is viable for the research and if there is a link between practice and values
Phase 5	Empirical observation, matching and redirecting Jul 2019 – Sep 2019	13 Interviews, Site Visits with all three cases, Initial coding, Writing up case history and description	Service ecosystems are conceptualised as a form of organisational fields with field-level practices, in which multiple logics are present in the organisational field
Phase 6	Empirical observation, matching and redirecting Oct 2019 – Mar 2020	21 Interviews, Preliminary within-case analysis, supporting with document analysis, establishing Trustworthiness	The framework was expanded and informed by literature about goal achievement and how value relates to and translates into goal achievement
Phase 7	Within-case analysis Jan 2020- May 2020	In-depth in and Cross case analysis, Document analysis, Establishing Trustworthiness, Write a provisional multi-case study	Each of the three cases was transcribed and coded and the framework was populated
Phase 8	Developing means-end chains Jan 2020-Apr 2020	Identify the most sustainable of the three cases and write a provisional single-case study	Validate the assumptions of how resources are integrated lead to different values
Phase 9	Develop framework May 2020-Dec 2020	Reviewing the literature and conceptualising the barriers and drivers	Expanding framework with components from institutional pluralism to better understand the source and nature of pluralism in institutional logic in the field
Phase 10	In-depth analysis and validation Jan 2021- Mar 2021	Cross case analysis	Validate the assumptions of sustainable resource integration and hinders its practice
Phase 11	Develop framework Mar 2021- Jun 2021	Suggest final framework, feed findings back into companies	Synthesise the framework and validate with the literature and data
Phase 12	Writing up findings in the thesis Jul 2021-Dec 2022	Developing the study into a coherent thesis document	Reviewing the most recent literature to validate and complement the research

1.5 Thesis Structure

This Chapter described the background of the research (1.1) and presented the research problem (1.2) and aim (1.3) of the research. The thesis commences as follows.

Chapter 2 presents the literature review and explores the extant research in the areas of value creation in customer solutions (2.1), resource integration (2.2), stewardship practice (2.3), goal achievement (2.4), different business logics (2.5) and presents a conceptual framework that guides the research (2.6).

Chapter 3 outlines the research design with its philosophical (3.1) and methodological (3.2) considerations. The Chapter then describes how the cases were selected (3.3), the data was collected (3.4) and analysed (3.5) and explains how the quality of the research is ensured (3.6).

Chapter 4 presents the method for the multiple-case study and (4.1) the both the within-case (4.2) and cross-case (4.3) analysis. The Chapter then presents the findings of the multiple-case study (4.4) and answers the first research question (4.5).

Chapter 5 presents the method for the single-case study (5.1) and the thematic (5.2) as well as the means-end chain analysis (5.3). The Chapter then presents the findings of the single-case study (5.4) and answers the second research question (5.5).

Chapter 6 discusses the findings of the research from the standpoint of business logics (6.1), sustainable value creation (6.2), and institutional logics (6.3). The Chapter then discusses barriers (6.4) and drivers (6.5) to sustainable customer solutions and presents the synthesis of the research in a proposed framework (6.6).

Chapter 7 concludes the thesis and presents the condensed research outputs (7.1) along with theoretical (7.2) and managerial (7.3) contributions, policy recommendations (7.4) and the limitations of this research and avenues for future research (7.5).

Figure 1-1 on the next page describes the golden thread through the research.

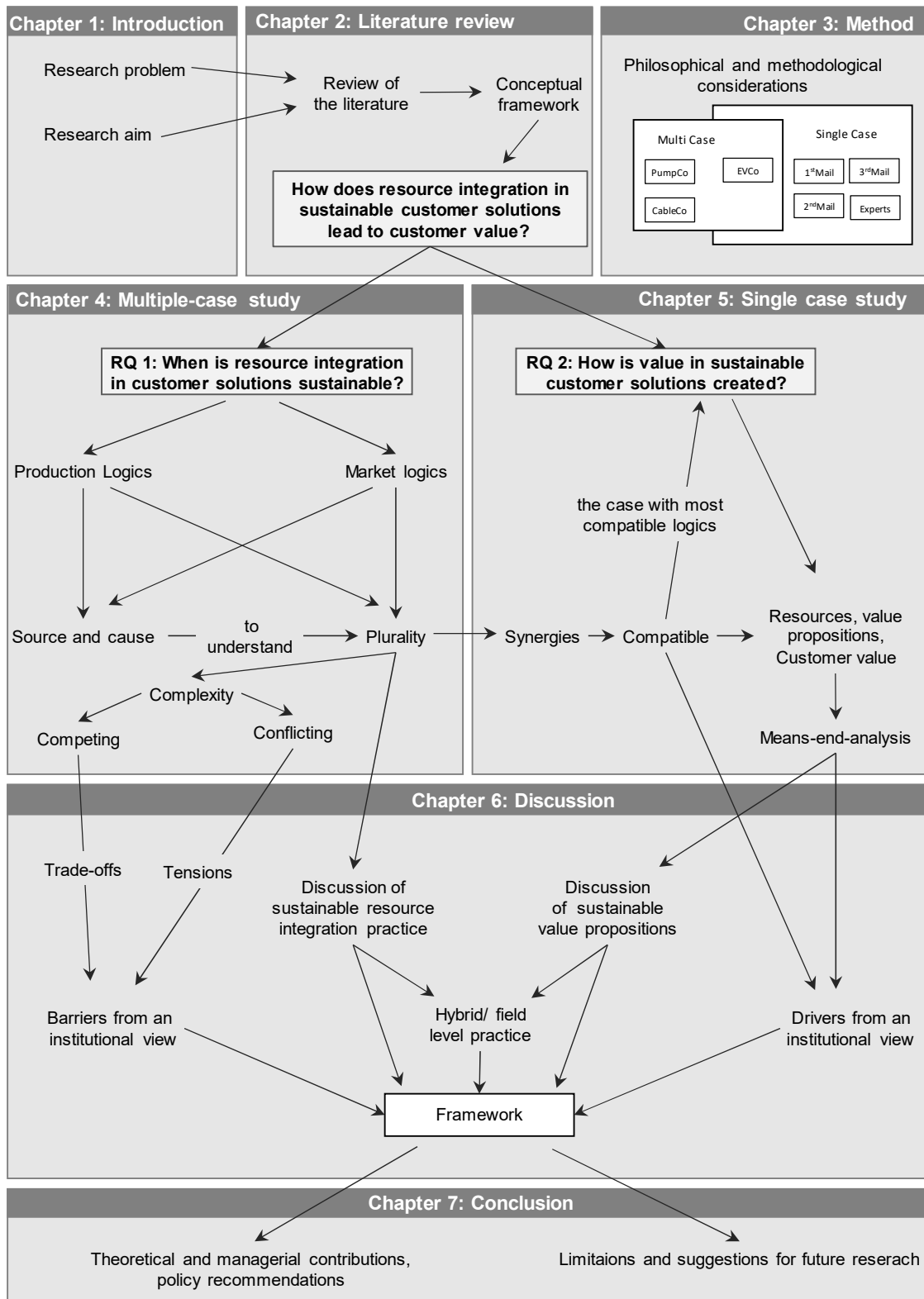


Figure 1-1: Thesis structure overview

2 LITERATURE REVIEW

The literature used for this research was identified and reviewed in multiple stages. In the first stage, a positioning study was conducted to mark out the field and identify the commonalities of circular economy and product-service systems. The findings of this positioning study were synthesised into the main themes business models and value, service-dominant logic as well as value and trade-offs for different stakeholders. With these themes in mind, two systematic literature reviews were conducted.

First, a systematic review titled "Exploring value manifestations in outcome-based contracting" was conducted. In conducting this literature review, a systematic approach was employed. The review involved the selection of relevant keywords (Product-service system, value, supply chain, circular economy) and the utilization of four major electronic databases (ProQuest, EBSCO, Web of Science, SCOPUS), to access a diverse range of scholarly articles and publications related to outcome-based contracting and value. Initially, a comprehensive query was executed across these databases, resulting in an initial pool of 1427 articles. After removing duplicates 800 articles went into the screening of abstracts and titles, narrowing down the selection to 145 articles. These articles then underwent a stringent quality appraisal process, further reducing the pool to 55 articles. To ensure the inclusion of seminal works, a snowballing technique was utilized. This iterative process involved tracing the reference lists of key papers and works to identify more related studies and achieve a comprehensive understanding of the topic.

This was followed by a discerning elimination of articles that did not significantly contribute to the research topic. In conclusion, after these systematic steps, a final sample of 61 articles was identified, representing the most relevant and high-quality literature for the comprehensive review.

Following the initial systematic review, an examination of the principles of a circular economy was undertaken. A second systematic review with the title "The values and principles of a circular economy - Systematic literature review on the emergence and

current state of the art" was conducted, specifically targeting literature on circular economy principles, management theory, and value.

This review used the keywords circular economy, value, benefit, sacrifice, and principle in the abovementioned databases. To expand the scope of the review beyond the initial set of literature, ad hoc searches were conducted using EBSCO and other resources. The review resulted in a pool of 273 articles after duplicates were eliminated. Following a thorough screening process, 100 articles were deemed suitable for further review and subsequent filtration. By consolidating the remaining articles from the search and seminal contributions in the field of circular economy principles, a total of 22 sources emerged, providing a nuanced perspective on the fundamental principles governing the circular economy.

This extensive exploration of the literature provided a solid foundation for the research, ensuring that the thesis was based on a comprehensive and up-to-date (inclusive of 2022) understanding of solution business, circular economy principles, management theory, and value creation. The two systematic literature reviews act as the basis of the literature review chapter. However, as explained in Section 3.2, the research uses systematic combining which requires a constant comparison of the empirical observation with the literature. The result of this process is a narrative review of the main bodies of literature presented in this chapter, which are value creation in customer solutions (2.1), resource integration (2.2), stewardship practice (2.3), goal achievement (2.4) and business logics (2.5)

2.1 Value Creation in Customer Solutions

Solution business and customer solutions (CS), as introduced in 1.1.1, are part of the phenomenon of combining tangible products with intangible services to jointly fulfil a customer's need. Research in solution businesses focuses on the integration and marketing of value propositions that are typically referred to as CS. This research community emphasises selling processes, customer relationship management, and value co-creation with customers, alongside related topics such as value-in-use (ViU), ownership, and

pricing models. The core debates also include the design of encounter mechanisms for involving customers in value co-creation (Rabetino et al., 2018).

2.1.1 Customer Perceived Value

A company's goals focus on particular outcomes it wants to achieve (Findsrud et al., 2018) which drive and direct the motivation to engage in processes that turn needs into goals (Taylor et al., 2019). Different stakeholders, past experiences within and outside of a business relationship, and the institutional environment (Eggert et al., 2019) influence a firm's goal setting, striving, and achievement (Taylor et al., 2019) and the intensity and persistence (Findsrud et al., 2018) with which they seek to realise value from CS to achieve their goals (Macdonald et al., 2016).

For the past two decades, customer value has gained interest as a source of competitive advantage (Parasuraman, 1997; Woodruff, 1997). Woodruff (1997) defines customer value as “a customer's perceived preference for and evaluation of those product attributes, attribute performances, and consequences arising from use that facilitate (or block) achieving the customer's goals and purposes in use situations.” The perception of the realised value is dependent on the situational mix of actor goals that underlie the motivation to enter into a marketing interaction (Taylor et al., 2019) and are not restricted to profit but also encompass ethical values such as principles, standards, ethics, and ideals that guide the actions of people and organisations alike. Edvardsson and Enquist (2011) argue, that if there is a resonance between an individual customer's norms and beliefs, a company's core values and organisational culture, and society's foundation values –it is likely that customer value will be enhanced and the wellbeing of a service ecosystem will be increased (Frow et al., 2019).

Value can be defined in two groups, instrumental and terminal value (Rokeach, 1973). Instrumental value is related to modes of behaviour and practices while terminal value is concerned with preferred end-states of existence which are in line with the individual's and organisation's values and beliefs. Most research in the domain of value in business seeks to explain how certain attributes translate into a certain usefulness of a product or

service (Lindgreen et al., 2012). This interrelation between the means-value and the end-value refers to a hierarchically organised value system of attributes that leads to benefits and ultimately result in value (Gutman, 1982) and are the foundation of a means-end chain approach in which customers are goal-directed and acquire and use products or services to minimise undesired consequences and to accomplish favourable ends (Khalifa, 2004; Sánchez-Fernández and Iniesta-Bonillo, 2007).

Established marketing research (Zeithaml, 1988) postulates a hierarchical linkage of three levels (Mentzer et al., 1997) between attributes of products, services, and behaviours preferred or sought by customers, benefits that are consequences that result through the use or consumption of attributes, and values of customers that form a chain of elements and underlie the decision-making processes of customers (Botschen et al., 1997) with value being at the highest level of abstraction (Zeithaml, 1988). When moving up the hierarchy, customers think about products as bundles of attributes and attribute performances and form preferences for certain attributes based on their ability to facilitate desired consequences, reflected in ViU and possession value. Moving down the hierarchy, customers use goals and purposes to attach importance to consequences, which guide customers when forming preferences of attributes and attribute performances (Sánchez-Fernández and Iniesta-Bonillo, 2007; Woodruff, 1997). Following this approach, in a means-end chain, the customer does not decide on a product category, but on functions, attributes, and experience attached to it (Khalifa, 2004).

In case the aim is to not only understand how value is created, but as well whether value is created, the extension with a benefits/cost ratio element (Khalifa, 2004) is required to create a perception of the concept of customer value creation based on use and exchange value. A customer's subjective overall utility of a product can be assessed based on perceptions of what is received and what is given, "value is what I give for what I get" (Zeithaml, 1988). The conceptualisation of value as a ratio of attributes and the price at the time of evaluation, or, the benefits and sacrifices involved in the acquisition of a good or service is an established concept in the marketing literature (Macdonald et al., 2016; Zeithaml, 1988). This ratio approach is well suited to describing value creation under the consideration of cost of ownership of the entire life cycle of a product or service,

including inventory costs, maintenance costs, running costs, and disposal costs (Christopher, 2011) and allows taking issues such as risk and uncertainty into consideration (Rapaccini and Visintin, 2015). A company's operations affect both the numerator and denominator of this customer value ratio (Christopher, 2011), and the judgement of whether value is created can be assessed by calculating the trade-offs of positive and negative consequences of desired outcomes (Khalifa, 2004) such as whether the price is lower than the expected value (Rapaccini and Visintin, 2015).

2.1.2 From Exchange Value to Value in Use in a Social Context

Philosophers as far back as Aristotle in the 4th century BC (Vargo and Lusch, 2008) and more recently Adam Smith in 1776 (Eggert et al., 2018) have thought about use - and exchange value, and argued that the word value has two different meanings, sometimes expressing the utility of some particular object, and sometimes the power of purchasing other goods which the possession of that object conveys. Traditional views of a goods-centred logic of value creation focused on the firm's internal resources and capabilities to create value and gain competitive advantage (Bowman and Ambrosini, 2000), whereas a more recent service-centred view argues that value creation and competitive advantage are the results of resource integration (RI) and value co-creation on a network level in a context (Edvardsson et al., 2011; Grönroos and Voima, 2013; Vargo and Lusch, 2004). Table 2-1 describes and compares the characteristics of value in exchange, value-in-use, and value-in-use in a social context.

The value proposition in a goods-dominant paradigm emphasise unidirectional communication to the customer via advertising, highlighting compelling product features or benefits that were not offered by competitors and deliver superior value to the customer (Eggert et al., 2018). In this paradigm, the roles of producers and consumers are distinct and value creation is thought of as a series of activities performed by the producer (Grönroos and Voima, 2013; Vargo and Lusch, 2008). The purpose of economic activity is to make and distribute goods that are standardised for maximum efficiency and output. These goods are inventoried until demanded by a consumer and sold with a profit. This transactional way of business suggests an orientation that emphasises short-term

outcomes and a clear winner in the exchange of value (Hartmann et al., 2018). For example, a manufacturer constructs an automobile out of raw materials that in their raw form cannot be used as a mode of transportation, but through the production process, the firm embeds value in the automobile by transforming raw materials into something the customer wants (Grönroos, 2008).

The logic that value is created in the form of economic exchange (Bowman and Ambrosini, 2000) dominated most of the early research (Vargo and Lusch, 2004). Resources since the 1950s' are increasingly regarded as "intangible and dynamic functions of human ingenuity and appraisal" (Vargo and Lusch, 2004) and are thus not static or fixed, nor can be captured and possessed. The differentiation of resources led Vargo and Lusch (2016, 2008, 2004) to distinguish the logic of goods- and service-dominant views (Vargo and Lusch, 2004). They suggest shifting the dominant view of the market from goods to services and to regard all value that is created as ViU, and that service is the fundamental basis of exchange. ViU focuses on the customer's outcome, the purpose or objective that is achieved through service (Macdonald et al., 2011) and emphasises the ongoing process in which customers through experiences extract value out of products and other resources used (Grönroos and Voima, 2013).

ViU is phenomenologically determined and socially constructed through experiences and is contextually dependent on changes in social, spatial, temporal, and physical aspects (Grönroos and Voima, 2013). ViU is further determined by the accumulated experiences with resources, processes, and contexts and are at the core of value creation and is not only affected by past and current experiences but as well from future expectations. Actors may seek support from institutional norms within their service system (Edvardsson et al., 2014) to assess whether the resources used and integrated by other actors are valuable in a specific context. Actors are constantly integrating and exchanging resources within a social system (Edvardsson et al., 2011).

Table 2-1: Value constructs

Value construct	Characteristics	Value propositions	Value realised	Role of resources	Actor engagement / customer participation
Value in exchange Authors: Hartmann et al. (2018) Bowman and Ambrosini (2000)	Goods-Centred Model of Exchange (Concepts: tangibles, statics, discrete transactions, and operand resources). The purpose of economic activity is to make and distribute things that can be sold with a maximised profit and that can be controlled and inventoried until demanded by a customer. Dominant market logic: Goods based	Through advertisement Compelling product features or benefits not offered by the competition; One-way offers without dialogue between customer and supplier	The customer creates ViU while using the product attributes provided by the customer; The producer is the creator of value; the customer is the destroyer of value through use and consumption	Operand Resources are integrated unilaterally downstream the supply chain from raw material to the end customer; Owned by the firm as inputs to production processes	none
Value-in-use Authors: Grönroos and Voima (2013) Vargo and Lusch (2004).	ViU is all customer-perceived consequences arising from a solution during the use of resources and processes that facilitate or hinder the achievement of a customer's goal. Dominant market logic: Service based	Co-produced between the customer and supplier	Both actors in the dyad are resource integrators who jointly co-create value	Resources are not, they become valuable in their use	Bilateral between the customer and the supplier Value creation takes place in spheres
Value-in-use in a social context Authors: Chandler and Vargo (2011) Edvardsson et al. (2011)	Value has a collective and intersubjective dimension and should be understood as value-in-social-context. The term value-in context thus refers to a multifaceted phenomenon that is uniquely and socially constructed between particular actors, including how value is perceived. Dominant market logic: Service based	Designed with the support of institutions	Resources are only valuable in a particular context; The way in which resources are assessed depends on the social context	Actors are connected via resources	All actors are resources

Actors and context are mutually constitutive. There is a continuous change in context and actors and they are partially defined by one another in a reciprocal and interdependent relationship (Chandler and Vargo, 2011). This makes ViU interactive, relativistic, and meaning-laden in a given context (Edvardsson et al., 2011). Resources are drawn upon for service across varying contexts, each context provides conditions under which different resources will and will not be valuable (Chandler and Vargo, 2011). Resources, such as for example brand reputation, are externally based of the firm, and therefore cannot be owned or controlled by a single actor such as the producing brand and their value is dynamically determined in the context (Chandler and Vargo, 2011).

From Shareholder Value to Stakeholder Value to Sustainable Value

Similar to the shift from value-in-exchange to ViU, which describes how value is created, the forms of how value is evaluated and attributed changed over the past decades. Initially, the idea of shareholder value described the purpose of a firm as creating the most economic value for the shareholders, the owners of a firm (Khalifa, 2004). Traditionally, shareholder value is a purely economic concept, which is driven by revenue growth, tax minimisation, fixed capital efficiency, operation cost reduction, and working capital efficiency and measured using indicators such as net present value, economic value added, and market value added (Christopher, 2011).

The shareholder view derived from the idea that because a company is ‘someone’s’ property, it only has to serve its shareowners. This, according to Donaldson and Preston (1995) is morally untenable. The authors suggested an approach in which companies not only have a responsibility towards shareholders but an extended responsibility that encompasses further stakeholders such as employees, customers, and society at large (Khalifa, 2004). In contrast to the idea that the firm has unidirectional relationships in its value chain and uses investors, suppliers, and employees to create value for the customer (Donaldson and Preston, 1995), the stakeholder approach suggests that all stakeholders are in bidirectional relationships with the firm.

Primary stakeholder groups are the ones without whose continuing participation the corporation cannot survive such as shareholders and investors, employees, customers, suppliers, and public stakeholder groups like governments and communities that provide the market for the firm's products and services. Secondary stakeholder groups are those who influence or affect, or are influenced or affected by, the corporation, but they are not engaged in transactions with the corporation, such as the media (Clarkson, 1995). More recently, future generations, society at large and the natural environment that needs to be protected and treated with care, are identified as secondary stakeholder groups as they are affected by the impacts of a firm's decisions and must be considered to create sustainable value (Bocken et al., 2013; Evans et al., 2017; Schenkel et al., 2015).

The understanding and interpretation of sustainability changed over the years. The commonly used definition of 'meeting the needs of the present generation while not compromising the ability of future generations to meet their needs' (Brundtland, 1987), framed by the World's Commission on Environment and Development, however, is still applicable and not outdated. With this definition, sustainability means more than the mere possibility that human and other life will survive, but that nature and all living beings will flourish and live in justice and dignity on earth for generations to come (Ehrenfeld, 2000).

To describe the phenomenon of taking profit, people, and planet into consideration, the term triple bottom line (TBL) is often used, describing an accounting framework that goes beyond the traditional measures of profit and shareholder value to include environmental and social dimensions in either monetary values or using an indexation (Slaper and Hall, 2011). Alternative referencing frames suggest using metrics that calculate the conceptual net sum of the costs (harms) and revenues (benefits) arising as a result of a firm's activities in each of the environmental, social, and economic contexts in a given time period measured in units appropriate to each (Upward and Jones, 2016).

Creating business value and reducing risks for the focal firm and multiple stakeholders, especially non-supply-chain actors, creates complexity, in particular when these stakeholders have ambiguous and conflicting interests (Schenkel et al., 2015). Creating sustainable value is not only a multidimensional challenge but as well multidimensional

opportunity (Hart and Milstein, 2003) in which businesses seek to better balance value creation for all stakeholders to eliminate conflicting demands and negative outcomes for any of the stakeholders (Bocken et al., 2013), including economic value forms (e.g. profit, return on investment, financial resilience, long-term viability, business stability), social value forms (e.g. equality and diversity, well-being, community development, secure livelihood, labour standards, health and safety), and environmental value forms (e.g. renewable resources, low emissions, low waste, biodiversity pollution prevention) (Evans et al., 2017).

2.1.3 Value Propositions in Customer Solutions

At the core of a company's value proposition lies a complex bundle of products, services and software which seamlessly integrate to solve a customer's specific problem (Bastl et al., 2012; Nordin and Kowalkowski, 2010). In the industrial marketing literature, customer value propositions are used to communicate the value a supplier's offering delivers to customers reflects the firm's core strategy and a promise on how it will serve its customers (Ballantyne et al., 2011; Payne et al., 2017). Value propositions in CS have been studied extensively and suggest a variety of benefits to the customer. A non-exhaustive list of possible benefits is comprised in Table 2-2 and includes:

- Competitive advantages (Hypko et al., 2010; Macdonald et al., 2016),
- Ease of life and minimised risk for the customer (Johnson and Mena, 2008; Macdonald et al., 2016; Nordin and Kowalkowski, 2010),
- Increased economies of scale and scope for the solution provider (Johnson and Mena, 2008; Toossi et al., 2013; Visnjic et al., 2017),
- Lock-ins and more predictable revenues (Hypko et al., 2010; Tukker, 2004; Visnjic et al., 2017),
- Overall higher quality of assets (Hakanen et al., 2017; Macdonald et al., 2016; Raddats et al., 2016; Toossi et al., 2013),
- Optimised operations (Visnjic et al., 2017),
- Increased dynamic interactions with customers that enable knowledge transfer (Hakanen et al., 2017; Johnson and Mena, 2008; Ng et al., 2009).

Extant research usually considers value propositions in terms of economic benefits, or monetary value, that the supplier's offering delivers to its customers but has largely ignored the environmental and social benefits that customers may also receive (Patala et al., 2016). A reason for the lack of other than economic benefits might be the difficulty of quantifying the environmental and social benefits that suppliers are able to deliver to the customer. Environmentally friendly offerings are usually technologically complex and deliver benefits that are relatively intangible in nature, such as improved end product quality, production process safety, and public image, or reduced environmental footprint, waste material, or energy usage. Since customers increasingly pay attention to environmental and social buying criteria and expect concrete evidence of their impact on business performance, suppliers need to quantify and communicate the economic, environmental and social benefits their offerings deliver to customers (Patala et al., 2016).

Research on the benefits of bundling products and services has been broadly discussed in different research communities, originating from both geographically different places and different drivers to do so (Lightfoot et al., 2013). Servitization describes the transformation process manufacturers go through in their shift from being a product provider to becoming a service provider with the aim of creating a competitive advantage (Brax and Visintin, 2017; Kowalkowski and Ulaga, 2017; Rabetino et al., 2018). Servitization commonly involves changes in the manufacturers' objectives, structures, competencies and culture (Baines et al., 2009; Oliva and Kallenberg, 2003) which are facilitated by different activities, supporting measures, new partnerships and operation models.

Table 2-2: Benefits for customers in solution business

Consequence	Description	Articles
<i>Affordability</i>	Customers benefit from a reduced financial risk and fixed capital.	Hypko et al. (2010), Lockett et al. (2011), Macdonald et al. (2016), Raddats et al. (2016), Tukker (2004), Visnjic et al. (2017)
<i>Competitive Advantage</i>	Solutions can create a competitive advantage when the solution improves the customer's own market position.	Hypko et al. (2010), Macdonald et al. (2016)
<i>Economies of Scale and Scope</i>	The provider's economies of scale and scope by cross-leveraging resources and capabilities can be used by the customer to negotiate with third-party suppliers.	Johnson and Mena (2008), Raja et al. (2013), Visnjic et al. (2017)
<i>Ease of Life</i>	Solutions overall aim to make life easier for the customer as risk is transferred to the provider which minimises the decision the customer must make so he can focus on his core offering.	Johnson and Mena (2008), Macdonald et al. (2016), Nordin and Kowalkowski (2010)
<i>Knowledge</i>	The high level of dynamic interactions and relationships in solutions can lead to better-trained staff in both the provider and the customer which may lead to cost savings and the development of new solutions.	Azarenko et al. (2009), Hakanen et al. (2017), Johnson and Mena (2008), Ng and Nudurupati (2010), Ng et al. (2009)
<i>Outcome Focus</i>	The customer value is centred on the outcome of the service with the aim to avoid downtime and a high degree of performance, availability, and reliability. Contracts are rarely formalised, and penalties are levied by the asset user for poor performance. A high degree of customisation solves the customers expressed and latent problems and ensures inconvenience caused by unavailability. The provider has no incentive for opportunism caused by the customer's downtime as he is paid per unit.	Baines et al. (2011), Gebauer et al. (2005), Hypko et al. (2010), Johnson and Mena (2008), Macdonald et al. (2016), Ng et al. (2009), Nordin and Kowalkowski (2010), Rapaccini and Visintin (2015), Reim et al. (2015)
<i>Lock-In</i>	Solutions allow exclusivity over a longer timeframe leading to predictable cost and protection against market uncertainty. The provider's and the customer's preferences (long and fixed vs. short and flexible) are more aligned due to the long-term contract.	Hypko et al. (2010), Tukker (2004), Visnjic et al. (2017)
<i>Optimised operations</i>	As the provider internalises processes and provides proactive maintenance, problem-solving is faster and the downtime is lower.	Hypko et al. (2010), Macdonald et al. (2016), Ng and Nudurupati (2010), Özkir and Başligil (2012), Visnjic et al. (2017)
<i>Social Status</i>	The social role in solutions changes as responsibilities and competences shift between the customer and the supplier which may lead to tensions but as well create new high-competence jobs within the customer's organisation.	Macdonald et al. (2016)
<i>Quality</i>	Customers evaluate solutions on how functional and physical capabilities serve their needs and it is ultimately quality and attributes thereof that determine ViU and is dependent on both social and technical dimensions.	Hakanen et al. (2017), Macdonald et al. (2016), Raddats et al. (2016), Toossi et al. (2013), Xing et al. (2013)

To understand servitization as a transformation, it is necessary to indicate its starting point as well as the final desired outcome expressed as the level of sophistication of the product-service offering. Introducing the product-service systems typology, also referred to as PSS, Tukker (2004) allocated main archetypes of product-service models under three main categories: product-oriented services (product-related services; advice and consultancy), use-oriented services (product lease; product renting or sharing; product pooling) and result-oriented services (activity management/outsourcing; pay by service unit; functional result). Similar to Tukker, Baines and Lightfoot (2009) explain the operations management practices of servitized manufacturers building on the typology with the three stages of base, intermediate, and advanced services. A comparison of these steps by Tukker (2004) and Baines and Lightfoot (2009) is listed in Table 2-3.

Despite the academic interest in advanced services, it is likely that the manufacturers on the servitization path try transitioning from base to advanced services, but might see intermediate service introduction as the most optimal final point of service development. Manufacturers might be developing intermediate and advanced services in parallel, all while relying on and growing the base services side of the service business, among other appropriate strategies. For the ease of reading, this research henceforth uses the term solution business regardless of the maturity of their servitization efforts.

Table 2-3: Stages of customer solutions on the product-service continuum

Type by Baines and Lightfoot (2009)	Type by Tukker (2004)	Outcome	Characteristics
Base services	Product-oriented services	Focused on product provision	Based on the execution of production competence such as product/equipment provision, spare part provision, warranty
Intermediate services	Use-oriented services	Focused on maintenance of product condition	Based on the exploitation of production competences to also maintain the condition of products such as scheduled maintenance, technical helpdesk, repair, overhaul, delivery to site, operator training, condition monitoring, in-field service
Advanced services	Result-oriented services	Focused on capability delivered through the performance of the product	Based on the translation of production competences to manage the products' performance such as customer support agreement, risk and reward sharing contract, revenue- through-use

2.1.4 Sustainable Customer Solutions

Sustainable business models create competitive advantage through superior customer value (Boons and Lüdeke-Freund, 2013; Lüdeke-Freund, 2010), contribute to sustainable development by delivering simultaneously economic, social, and environmental benefits (Hart and Milstein, 2003). They seek to better balance value creation for all stakeholders to eliminate conflicting demands and negative outcomes for any of the stakeholders (Bocken et al., 2013). Ideally, the starting point towards sustainable business should not be legal or moral arguments as they may lead to an underestimation of strategic business opportunities, but linked directly to shareholder value, arguing that if shareholder value creation is multidimensional, so must be sustainable value creation and firms must perform well simultaneously in all dimensions to maximise value over time (Hart and Milstein, 2003).

For the development of sustainable value propositions, business-society dialogues must identify trade-offs and win-wins between the economic, environmental, and social dimensions (Boons and Lüdeke-Freund, 2013) for the optimal product and service performance throughout the product's life cycle (Patala et al., 2016). To develop sustainable value propositions, not only changes in the physical products but as well the processes and operating procedures need to be viewed in a more holistic, system-thinking approach (Evans et al., 2017). It should be an iterative process, in which relevant stakeholders are identified and the value propositions are discussed, the sustainability problem is redefined and addressed to create shared value, and tested to create prototypes of the product or service idea and its features are verified (Baldassarre et al., 2017).

Different business models provide firms assistance in exploring new ways to create and deliver sustainable value and developing the business model structure to realise new opportunities (Bocken et al., 2014). Research in product-service systems is interested in the change of use and behaviour of consumption when shifting from product sales to service offering, oftentimes under the beneficial outcomes for the natural environment by using fewer resources through different business models (Tukker, 2004). Findings from research in product-service system addressing design- and sustainability-related concerns

(Tukker, 2015, 2004) can be used to develop CS based on eco-design, cleaner production, efficient delivery, and remanufacturing (Rabetino et al., 2018). Certain aspects of CS such as performance-based pricing and change in ownership structures suggest that they are suitable to be more sustainable by reducing resource consumption and increasing efficiency (Bocken et al., 2014; Evans et al., 2017; Lüdeke-Freund et al., 2018; Ranta et al., 2019). For example, by being paid for the outcome of the product rather than selling the product to the customer, a manufacturer may be incentivised to develop products that last longer. Firms can prolong the lifetime of products by designing them for upgradability, reparability, and potentially reduce resource consumption throughout the product's life cycle. Most importantly, selling a service rather than a good, breaks the link between financial profit and production volume (Bocken et al., 2014).

2.2 Resource Integration in Customer Solutions

2.2.1 Value Creation

The main purpose of solution businesses is to create customer value. Companies in a service-ecosystem engage in RI because they are motivated to achieve their goals (Findsrud et al., 2018) in accordance with their expectations, needs and capabilities (Gummesson and Mele, 2010). They do so with the expectation to realise potential value (Edvardsson et al., 2014). Research in traditional industrial markets where customers and suppliers work in close collaboration within dyadic relationships, multilateral networks, and ecosystems has expanded significantly with a variety of concepts such as co-design and co-development of value propositions, co-learning, and co-innovation. (Kohtamäki and Rajala, 2016). The focus on creating ViU no longer lies on the price exchanged for the bundle of products and services, but rather on the experiences, logic, and ability to extract value out of products and other resources used (Grönroos and Voima, 2013; Nordin and Kowalkowski, 2010). It is the provider's job to identify, prepare, and facilitate opportunities for the creation of value in the customer's use situation and provide resources as a foundation for value creation (Eggert et al., 2018) while the customer combines these resources with other resources to transform the potential value into ViU.

Value creation in CS goes beyond the supplier-customer dyad into a network that creates a service-ecosystem and moves away from sequential value creation where a focal firm manages its processes to deliver value to customers through a supplier value chain to a perspective of multiple actors, who co-create value in networks with numerous stakeholders that contribute to value and expect value in return (Gummesson and Mele, 2010). The focal firm as an orchestrator selects and mobilises the necessary actors for the intended value contribution, such as logistic providers, suppliers, but as well the customer itself to address the customer's business and operational needs comprehensively (Gebauer et al., 2013). They do so to configure the resources in a way that facilitates the creation of ViU.

The change to shift from traditional transaction-based business to CS requires new capabilities to manage the increased network complexity, given the many inter-firm structures. Complexity-related challenges in network orchestration arise from the supply base and industry structure that become more and more diverse, changing in the actor roles, and changes in the power structures of the market (Eloranta and Turunen, 2016). The organisational aim of the service-ecosystem is to increase a firm's offering without increasing complexity in internal structures (Eloranta and Turunen, 2016). The more actors and resources are involved in the network, the likelier it is that the orchestration is not managed by a single actor, but represents a collaborative effort within an intentionally formed network (Perks et al., 2017). The value of networked organisations that lead to the well-being of the entire service-ecosystem lies in the companies' relationships, rather than the internal assets (Frow et al., 2015).

2.2.2 Resource Integration

At the core lies an actor that integrates their own resources with the resources of other actors depending on the individual, relational, and collective goals the actor tends to achieve (Grönroos and Voima, 2013). Resource integration refers to the process of cooperative and collaborative processes and interactions between actors in which they arrange and interact in a service-ecosystem network to bring together diverse products

and services to create value in accordance with their expectations, needs and capabilities (Gummesson and Mele, 2010; Tuli et al., 2007).

The motivation for RI can mainly develop out of complementarity, redundancy, or a mix of both. Actors can have resources available that supplement each other and so they have to be incorporated in a manner that adds what is missing and form a whole. The requirement for these networks is caused by the individual company's inability to create a CS with its supporting complex technical products on their own, and specialisation, therefore, forces them to collaborate with suppliers and intermediaries (Finne and Holmström, 2013; Johnson and Mena, 2008).

Actors can as well integrate resources by sharing redundant resources and merging resources and processes that are similar or overlapping. In any occurrence of RI, there can always be a mix of both, the integration of similar and different resources (Gummesson and Mele, 2010). The interaction between the actors serves as a forum to evaluate available and potential resources to understand what they have and what they need. The generic A2A perspective suggests that especially in an industrial environment, companies oftentimes are both suppliers and customers at the same time that integrate resources and engage in service exchange in the process of cocreating value (Vargo and Lusch, 2016).

Based on service-dominant logic, Kleinaltenkamp et al. (2012) present a conceptual framework that describes the resource integrators as actors, the resources involved, the resource integration practice, the value created and its evaluation. The authors' framework as depicted in Figure 2-1 suggests that RI is a process with closed feedback loops moving between the resources integrated and the value created at a certain point in time.

Resources are the tangible and intangible entities available to a firm that can be used to produce efficient and effective market offerings to market segments (Madhavaram and Hunt, 2008). Operand resources are physical, visible, tangible, static, and finite such as raw materials, while operant resources are invisible, intangible, dynamic, and infinite - such as skills and knowledge (Peters et al., 2014). Operant resources can as well be organisational (e.g., controls, routines, cultures, competences), informational (e.g.,

knowledge about market segments, competitors, and technology), or relational (e.g., relationships with competitors, suppliers, and customers) (Madhavaram and Hunt, 2008). In a CS, operations and acts are performed on operand resources by operant or operand resources to produce an effect. The evaluation of the ViU as a result creates feedback that may change the actors' choices and/or the processes that lead to the value co-creation. RI is the main mechanism for value cocreation for which actors strive for the best matching between resources, activities, and processes to achieve their goals. The more precise the matching of resources, the greater the value (Gummesson and Mele, 2010).

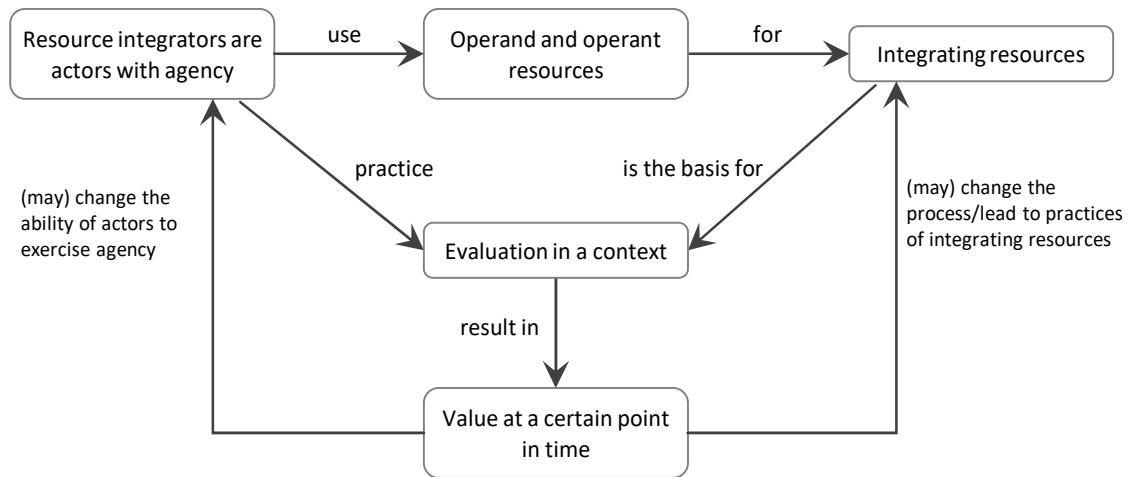


Figure 2-1: Resource integration framework from Kleinaltenkamp et al. (2012)

The quality of a CS not only depends on the supplier's resources and processes, but the joint RI of the customer's resources and the quality of the customer's resources are instrumental to contributing to ViU (Macdonald et al., 2016). All resources possess potential value but have no real value in themselves. They only become valuable in specific contexts with specific intentions during the RI (Edvardsson et al., 2014). In interactions prior to the RI, the actors partake in a dialogue in which they make their resources available and compare ideas, knowledge, and experiences. Making the resources available activates the value-creating process (Gummesson and Mele, 2010) and in a sense, the value proposition in a CS is itself cocreated through the RI process (Macdonald et al., 2016).

2.2.3 Practices in Customer Solutions

The RI practice in CS take place in service-ecosystems with dynamic relationships in which customers' and suppliers' resources are integrated and utilised to co-creating customised and flexible product-service bundling. Life cycle thinking is a distinguishing characteristic of CS and, as opposed to a product ML, seeks to identify possible solutions to improve goods and services by reducing resource use and environmental impacts throughout the entire product life cycle (He et al., 2016; Yang et al., 2017).

Within CS, life cycle thinking is especially compiling, as a service ecosystem is orchestrated by the provider. When developing a new CS, the provider can take a fresh look at the entire system to create shared value for various stakeholders in the ecosystem (Visnjic et al., 2017). The actors in the network are heterogenous and CS require a change from a one-direction and clearly boundaried linear thinking of manufacturing environment, to an interactive fluidly boundaried complex service system with a supplementing network that includes operand and operant resources of both the service provider and the customer and suppliers (Mont et al., 2006; Ng and Nudurupati, 2010). During a certain period of time, these networks of collaborating companies function and act as a single temporary entity to deliver a solution (Pawar et al., 2009).

The activities related to the flow of goods from the supplier to the customer are referred to as forward supply chain management. In solution businesses, in many cases these are followed by reverse supply chain management to close the material flow from the end customer, initiated by collecting products from end customers after their use (Özker and Başligil, 2012). Integrating both forward and reverse supply chains is described as closed-loop supply chains (see Figure 2-2). The more complex such a system is, the more the supply chain moves towards dynamic nonlinear systems with time delays and complex feedback loops (Ng et al., 2009). The relationship and the configuration between the components and the system, such as employees, customers, and technologies, are as important as the components themselves to guarantee an over all system availability. Therefore, flawless information-flow processes are required in the provision of servitized

goods to monitor the assets and use real-time data to ensure overall system availability (Johnson and Mena, 2008).

The potentially multiple lifecycle stages of CS consist of the beginning of life (BoL; including the concept, design, plan, source, manufacturing, delivery, and installation phase), mid of life (MoL; the use phase with monitoring and maintenance, operation, and support) and the end of life (EoL; including the collection, recovery strategy, redistribution, disposal phase or the introduction into a secondary market). Thinking about the entire lifecycle highlights the potential of the solution provider's stewardship role and the possibility of multiple life cycles and the EoL strategies (He et al., 2016; Özkir and Başligil, 2012; Yang et al., 2017). These strategies allow to maximise material longevity are discussed during the design phase and not just when the product has functionally failed (Rashid et al., 2013).

Equipment should not only have closed-loop supply chains, but also products that are designed with multiple life cycles in mind, and life cycle thinking in CS should be more than just harvesting parts when products are not working any longer (Rashid et al., 2013; Visnjic et al., 2017). Collaboration with customers and systems integrators in the BoL allows the development of the systems and assets with a predefined life time with an ensured performance over that period, and a predetermined EoL with the optimal recovery strategy planned (Johnson and Mena, 2008; Rashid et al., 2013)

Upon the end of a technical life cycle or the financially viable contract time, products at the EoL are disposed of, recovered or introduced into a secondary market (Johnson and Mena, 2008). In some CS, the provider may retain ownership over the products involved in providing the service and takes on the responsibility for the EoL strategies. At EoL, reverse logistics return the product from the customer to the service provider or a third-party company which decides on the most suitable recovery strategy (Asif et al., 2012). The recovery strategies have a hierarchical component, distinguishing between (Asif et al., 2012; Ellen MacArthur Foundation, 2015a; Özkir and Başligil, 2012): (I) Maintain, Clean, Refill, (II) Repair, Refurbish, Upgrade, Reuse, (III) Remanufacturing and part harvesting, Material recycling (IV) and (V) Scrap and energy recovery.

The supply chain network to support the different recovery activities is ideally decentralised to keep the transportation costs and emissions low and process residues local. Such decentralised supply chain networks are more resilient and diverse as external effects only affect the supply chain locally rather than disturb it globally. Depending on the complexity of the product, the EoL differs. For highly specialised and complex technical systems there might not be any EoL scenario planned due to the specialisation of the involved components (Johnson and Mena, 2008). Open supply chains may occur if a third party performs the product recovery and the artefact is resold, cascaded into a different market or if there is simply no aftermarket (Asif et al., 2012).

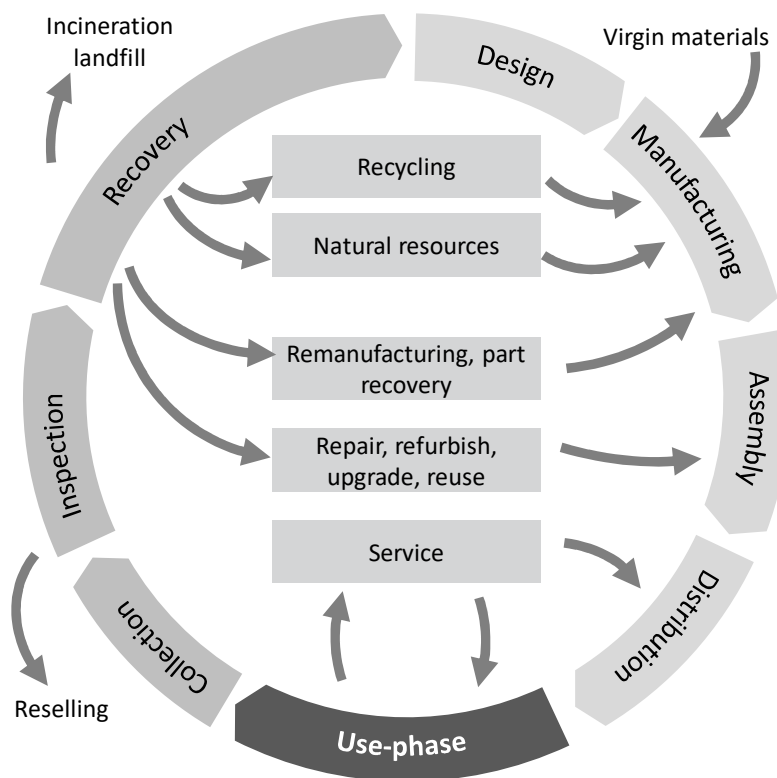


Figure 2-2: Supply chains in sustainable solution business from Widmer et al. (2018)

2.3 Practising Stewardship

Stewardship is about accountability that might be shared or wholly owned by an individual, organisation or community as one way a company can contribute to sustainable development (Ehrenfeld, 2000). As described in Section 2.1, creating not only economic but as well social and environmental value form is increasingly important in all business relationships, including CS. In addition to the RI practice for customer solutions described in 2.2, this section presents further practices that manufacturers can pursue in their RI to become more sustainable.

2.3.1 Stewardship Definition

An organisation that takes on stewardship is responsible for the management of all decisions and activities throughout the lifecycle of the products and services, including what happens upstream in the supply chain and downstream with the customers (BSI, 2017), taking into account economic, environmental and social issues both now and in the future (Ehrenfeld, 2000). All actors in society, individuals, firms, governments, and other institutions must act responsibly and take care of the future as if it belonged to them today and share ecological resources in a way that allows human and all species to satisfy their needs and human aspirations (Ehrenfeld, 2000).

Stewardship considerations in the supply chain include understanding the origin of raw materials, not minimising the natural capital, and having strategies for the management EoL of products in place. Another, closely related principle is the willingness to be transparent in organisational decisions and activities and the willingness to communicate these in a clear, accurate, timely, honest, and complete manner. Transparency in the supply chain, such as provenance, the composition of materials, repair manuals, or EoL measures, is favoured and should be available and made accessible proactively or upon request. Issues around stewardship are commonly discussed in two main fields, corporate social responsibility (CSR, Section 2.3.1.1) and extended producer responsibility (EPR, Section 2.3.1.2). While CSR is interested in the sustainability of the entire organisation, EPR predominantly focuses on the physical products a company produces.

To identify different levels of maturity of stewardship, the BSI (2017) suggest different levels for practising stewardship in the RI. As long as the stewardship practice is unformed, the organisation focuses on addressing public relations/marketing issues and/or regulatory requirements but has no real genuine focus on stewardship BSI (2017). Once the organisation has a basic practice, it improves knowledge and understanding of the organisation's direct and indirect environmental and social impacts related to resource management. At the next level, the practice is improving, and some environmental and social risks and opportunities related to resource management are beginning to be considered in decisions and activities. When the organisation is engaged in stewardship practice, environmental and social risks and opportunities related to resource management across the value chain are known and understood by the organisation. In the final, highest stage, the organisation is optimising its stewardship practice and can demonstrate it is actively managing the direct and indirect impacts of its decisions and activities across the value chain. This might include actively engaging in industry or multi-stakeholder advocacy and/or collaborations to tackle systemic issues.

2.3.1.1 CSR

Corporate social responsibility (CSR) in the management of an organisation refers to the voluntary contributions to a better society and a cleaner environment. It is about the management of stakeholder concerns for responsible environmental, ethical and social corporate behaviour (Arendt and Brettel, 2010). The voluntary nature of the concept underlines the need for CSR to go beyond simple compliance with legislation. The business case for CSR, however, is one that in manages the variety of stakeholders that have an important influence on their licence to operate and by doing so increase economic benefits (Kovács, 2008).

CSR is embedded in the idea of sustainable development and embraces the actions, operations and initiatives by businesses that contribute to an improvement of social equality and environmental quality, by voluntarily going beyond the organisation's legal obligations. The organisation's undertakings have to be in line with the legal, ethical, and philanthropic responsibilities of all relevant stakeholders, in contrast to a shareholder

perspective that is strongly directed at generating and maximising profit for the organisation's owners (Esken et al., 2018). CSR is the management of stakeholder concerns for responsible and irresponsible acts related to environmental, ethical, and social phenomena in a way that creates a corporate benefit. It is actively improving the quality of life or well-being in society, obeying societies' interpretations of right and wrong.

The creation of a strong positive reputation and image is recognised as an important factor in the success or failure of virtually all major organisations and a source of competitive advantage (Arendt and Brettel, 2010). By doing so it creates an interdependence of social and environmental responsibility and the economic interests and the joint achievement of strategic objectives and resolving social issues (Esken et al., 2018). Stakeholders, however, are becoming sceptical as to whether organisations engage in CSR for worthy and altruistic reasons or mere marketing plays to increase profits (Arendt and Brettel, 2010).

CSR, in industry reality, oftentimes has implementation challenges and credibility issues. Although companies are overall increasing CSR activities, it is oftentimes hard to evaluate the underlying motives. Such challenges make customers suspect companies of 'greenwashing' and make it difficult to understand the specific consequences and effects of engaging in CSR (Arendt and Brettel, 2010). Challenges include concerns that companies lack definitions and a common understanding of sustainability which requires defining and maintaining stewardship practices in their context according to the company's culture (Held et al., 2018). In many cases, CSR is not seen as an integrated activity for developing sustainable supply chains, but one that managers use to improve sales, in particular for environmentally concerned customers from northern Europe (Chiarini and Vagnoni, 2017). The further away a company is from the environmentally conscious end customer, the higher up in the supply chain so to say, the less environmental responsibility can be found (Kovács, 2008).

2.3.1.2 EPR

Extended producer responsibility (EPR) is a policy tool. It promotes stewardship through improvements of products, and shifts the burden of waste management cost for the EoL of products from local governments to the original manufacturer (Lai et al., 2014). In doing so, it extends pollution prevention beyond the manufacturers' factory gate. Major EU policies that demonstrate a strong commitment to EPR and force manufacturers to take on physical and financial responsibility over post-consumer waste management include (Corsini et al., 2015; Hojnik, 2018):

- The Directive on End of Life Vehicles (ELV) 2000/53/EC,
- The Directive on Packaging and Packaging Waste 94/62/EC,
- The Directive on Waste Electrical and Electronic Equipment 2002/96/EC (WEEE),
- The Directive on Restriction of Hazardous Substances (RoHS) 2002/95/EC,
- The Directive for the management of the collection of used batteries and accumulators 2006/66/EC.

Most EPR instruments are concerned with product recovery targets, environmental performance standards, disposal charges, and charges for environmental impact during product use (Subramanian et al., 2009). The EPR regulations in the EU alone affect thousands of firms handling millions of tonnes of waste, but the directives mostly are guided by waste and recycling, rather than a proactive stewardship practice. The implementation and enforcement of EPR regulations has a variety of different intertwined challenges, in particular as EPR regulations mostly govern companies on a local level. Product supply chains are however global. The result is that material loops are not as intended, closed, but products such as electronic equipment get shipped back to Asia-Pacific regions which does not resolve the problem of resource efficiency (Corsini et al., 2015). Atasu and Subramanian (2012) found that EPR regulations in which individual companies are responsible for the waste they create would incentivise market participants more to engage in design for recovery, as the investment they make into such

developments would feed back into their operations. Without these mechanisms, the incentives for design improvements are lost.

Most of the current laws on EPR such as the WEEE directive are based on a collective producer responsibility in which the responsibility is allocated to a product category, and not into individual producer responsibility in which each company is responsible for the takeback of their own products. Manufacturers find lower incentives for design for recovery under collective producer responsibility as competing firms can free-ride and benefit from not investing in this development and therefore offer their products at a lower price, as the recovery costs are averaged to all manufacturers.

Collective EPR could indeed lead to a negative incentive and increase the consumption of raw materials as free-riding manufacturers can offer their products at a lower price in the competitive equilibrium at the expense of the customers buying from manufacturers which implemented design for recovery. Financial and strategic implications to align with new legislation related to extended producer responsibility leads to significant costs for manufacturers. The acquisition or development of the required capabilities, the internal and external organisational skills, resources, and functional competencies developed within firms to match the requirements of the external environment, in the end, depend on both the competitive priorities and the need for legitimacy in the form of compliance with regulations (Miemczyk, 2008).

2.3.2 Describing a Circular Economy

The idea of a circular economy (CE) is not new and has evolved over time. No unified definition exists, and CE has been described as a concept, a framework, or a paradigm. CE is an umbrella construct (Hirsch and Levin, 1999), collating different schools of thought that have developed over the last decades. The construct compiles knowledge about resource life-extending strategies in a systemic manner and presents a platform for academia, policy and practitioners to discuss and develop these strategies further (Blomsma and Brennan, 2017).

CE is not accountable to one person but is an anthology of different views of achieving a more sustainable, waste-free society that has no net effect on the environment. During 1960–1985 in the “Preamble” Period, first research discussed waste management and the negative effects of waste, with Kenneth E. Boulding’s describing the earth as a spaceship on a long journey in possession of limited resources in a closed “circular” system, with limited assimilative capacity (Blomsma and Brennan, 2017).

In 1976 Walter Stahel and Genevieve Reday advocated in their report to the European Commission the positive impact of an economy in loops on waste prevention, resource savings, economic competitiveness and job creation (The Product-Life Institute, 2016). The authors described an economy based on spiral loops of reusing, repairing, reconditioning, and recycling that minimises matter, energy-flow and environmental deterioration without restricting economic growth or social and technical progress. Importantly for the understanding of CE, Stahel later added a hierarchical component which requires the loops to be as small as possible following the rule “do not recondition something that can be repaired, do not recycle a product that can be reconditioned economically” (Stahel, 1984). He argues that for the highest economic rewards, the optimising activities need to be designed in a way that reduces the transfer of products from one user to the next to prevent unnecessary material flow. That leads to his conclusion that the local reuse after refurbishing and quality check is the most profitable strategy. This as well leads to a more distributed, rather than centralised, economic system creating new local jobs and resulting in geographically closer supply chains (Stahel, 2008).

In the later “Excitement Period” from 1985–2013, authors suggested that waste can be a positive force and interest in product-service systems increased and related strategies such as product longevity, repair, refurbishment, upgradeability, and remanufacturing were coined (Blomsma and Brennan, 2017).

The term “Circular Economy” is accredited to Pearce and Turner (Pearce and Turner, 1990) who introduced it in 1990 (Andersen, 2007; Ghisellini et al., 2016; Lieder and Rashid, 2016; Su et al., 2013). Pearce and Turner defined economic functions of the

environment and linkages which describe material balance principles and the flow of material and resources through the economic system. German chemist Michael Braungart introduced the idea of a *Cradle to Cradle* economy, advocating lifecycle thinking and differentiating in biological and technical materials (McDonough and Braungart, 2010). More recently Biomimicry, Natural Capitalism and the Blue Economy systems approach are regarded as means to shift towards a CE (Ellen MacArthur Foundation, 2015a; Pomponi and Moncaster, 2017). Currently, the concept is in the “validity challenge period”, since 2013, in which vast scattered knowledge in theory and practice about different life-extending strategies include reuse, recycling, remanufacturing, servitization, repair, waste-to-energy, product longevity approaches, and the cascading of substances. An explicit theoretical or paradigmatic clarity regarding the CE concept is missing.

Common recent definitions of CE include certain principles (see Section 2.3.3) such as a systems perspective or waste hierarchy, business models that enable sustainable consumption and production, and the aim of achieving sustainable development (Kirchherr et al., 2017). Another defining characteristic of CE is that it enables a waste-free society that is more resilient and fair, but a nevertheless growing economic production and consumption system (Kirchherr et al., 2017; Korhonen et al., 2018a). This creates value by improving systemic resource efficiency and circulation of materials through closing resource loops and reducing resource flows through the economic system. Ranta et al. (2018b) argue that waste does not exist, but that all wastes are nutrients (Corbett et al., 2018; Ellen MacArthur Foundation, 2015a; Kirchherr et al., 2017) and that at the core of CE is the “circular advantage” of turning waste into wealth (Lacy and Rutqvist, 2015). CE is particularly well suited for a green economy because it encourages economic growth, which other concepts such as De-Growth as suggested by Georgescu-Roegen (1977) and a Steady State Economy described by Daly (1993) suggest to downscale economic activity to a level where production and consumption increases human well-being and enhances ecological conditions at the local and global level. This renders those concepts as socio-politically utopian at the present state of affairs.

Circular economy is an antonym of a linear economy and production systems which convert natural resources into waste via production, deplete natural capital and virgin resources, and reduce natural capital through waste and pollution (Murray et al., 2017). In a sense, the term linear logic describes the traditional way of how 20th-century economics worked and contrasts it to circular logic for the days ahead. This new way of handling increasing resource scarcity and natural degradation challenges the still prevailing modus operandi of a linear economic model in which society takes materials, uses them to make products and then disposes of them (Cumming, 2019). The linear economy was made popular by CE advocates to define an economy which converts natural resources into waste, via production, depletion of natural capital and virgin resources and the reduction of natural capital through waste and pollution (Murray et al., 2017; Widmer and Prior, 2019).

2.3.3 Circular economy principles to identify stewardship practice

The idea of CE, as opposed to more traditional and reactive approaches to sustainability, is that environmental stewardship is proactively practised (Geissdoerfer et al., 2017) with the aim to achieve a positive triple-bottom-line (Esken et al., 2018). However, while CSR tries to take social and environmental responsibility and tries to incorporate it into economic profit, CE has a more balanced approach and is more integrative and systematic. Hence, CE is not a balancing act between the three dimensions of sustainability strategically building interdependencies between the three that lead to sustainable development. CE, as opposed to more traditional CSR, defines clear quantifiable goals on how to make better use of resources, reduce waste and eliminate leakage and by doing so is about being/doing good, not just less being/doing bad (McDonough and Braungart, 2010).

The concept of CE is socially constructed and so are what is determined as waste or value. The concept of waste and value is dynamic and changing due to changes in culture, society, community, history, and level of societal development. These definitions in scientific research have to be set into their temporal, spatial, and cultural context and are community-based social constructs. The shift towards a CE can be regarded as a shift in

paradigm, for which novel practices must become the new business-as-usual (Ehrenfeld, 2000). The paradigm constraints a set of structures on top of which social action is created, or a vocabulary for describing things, or a story the actor tells about their place in the world (Ehrenfeld, 2000). Korhonen et al. (2018b) identified that research in CE can be categorised at a practice stage, including discussion tools, metrics, instruments, indicators, and measures for circularity, and at a paradigm stage, which is interested in norms, values, world views, visions, and concepts.

For a paradigm shift to occur, the paradigm must be embedded in everyday life, which one cannot easily perceive (Korhonen et al., 2018b; Widmer and Prior, 2019). For companies, it is inherently difficult to measure circularity in their business, because it is both a change in the culture as well as a change in production. To identify different levels of maturity of stewardship, the BSI (2017) suggest different levels for practising stewardship in the RI:

- *Unformed*: The organisation focuses on addressing public relations/marketing issues and/or regulatory requirements, but has no real genuine focus on stewardship (e.g., complying with rules for managing on-site waste and ensuring contracts are in place for recycling and disposal)
- *Basic*: Improved knowledge and understanding of the organisation's direct and indirect environmental and social impacts related to resource management.
- *Improving*: Some environmental and social risks and opportunities related to resource management beginning to be considered in decisions and activities. Little active management of issues beyond the organisation's direct control.
- *Engaged*: Environmental and social risks and opportunities related to resource management across the value chain are known and understood by the organization. Key issues are factored in decisions and activities of relevance to stewardship. Some programmes are in place to tackle indirect issues.
- *Optimising*: Organisation can demonstrate it is actively managing the direct and indirect impacts of its decisions and activities across the value chain. This might include actively engaging in industry or multi-stakeholder advocacy and/or collaborations to tackle systemic issues.

To complement the previously given definitions of what a CE is, an understanding how a CE is realised is equally important and discussed in the form of principles. Principles are used to describe a fundamental basis of a system of thought or belief for a chain of reasoning (Oxford Dictionary, 2017). CE principles are the moral rules governing behaviour and decision-making with the aim to stepwise transform from a linear to a CE (Widmer et al., 2018).

In order to align with the institutional environment an organisation is in, the organisation has to follow these principles in its decision-making process. Guided by this definition, a set of principles guides the decision-making of an individual within an organisation to do *A* instead of *B* in order to achieve what is morally pursued, - in this case, sustainable development. Over the past decade, scholars, professional bodies, and other institutions have described the social norms and rules in the form of guiding principles to transform the current linear into a CE as Table 2-4 presents (Widmer et al., 2018).

A challenge in collating and defining CE principles is to find the balance between abstraction and detail, Yong (2007) describes the “3R Principles – reduce, reuse, and recycle” on three levels, while others differentiate in more complex definitions. Without trying to identify higher-order themes, the guiding principles for a more CE are synthesised from the literature as follows.

To minimise the use of primary resources, the “3R-principles” of reducing, reusing, and recycling (some authors add recovery to these principles) on a micro- (enterprise), meso- (industrial park) and macro- (regional) level are a fundamental principle. As a primary guideline, efficiency reduces the requirement for more raw materials, prolonging life through repair and remanufacturing helps to reuse products to a maximum capability, and recycling reduces the consumption of virgin materials for part production. In the last instance, recovery of energy such as incineration aims to extract energy stored within the material. For the highest impact, these steps are hierarchically ordered to preserve more of a product’s value as it keeps and restores its integrity, complexity and embedded labour and energy (Ellen MacArthur Foundation, 2015a; European Environment Agency EEA, 2016; Kirchherr et al., 2017; Yong, 2007).

In 2005 the central government of the Peoples' Republic of China formally introduced CE as a development strategy to face increasing resource scarcity and pollution (Su et al., 2013). The closed flow of materials together with the use of raw materials and energy through multiple phases is at the core of a CE, which thus expects to achieve an efficient economy while discharging fewer pollutants. The government adopted the “3R principles” as they cover both the production and consumption of resources which lead to broad coverage of these principles in Chinese research in the following years (Yong, 2007).

Not only does a CE address economic and environmental concerns, but it also aims to meet present needs without jeopardising future needs. To ensure social prosperity and equity, the use of scarce and finite resources must be minimised, energy must be produced from renewable sources and natural capital has to be used in a regenerative way. The biological material should be allowed to re-enter the biosphere safely for decomposition and to regenerate into new value (Brundtland, 1987; Ellen MacArthur Foundation, 2015a; Kirchherr et al., 2017; Lieder and Rashid, 2016).

In a CE, waste does not exist. Waste should be turned into wealth by re-entering it as inputs into the supply chain using new technologies and materials. Products can be cascaded across multiple diverse applications along the value chain to avoid leakage of material and destruction of value through loss. By doing so, negative external effects such as landfilling can be turned into possible benefits for both technical components and materials, as well as biological nutrients (Andersen, 2007; Ellen MacArthur Foundation, 2015a; European Environment Agency EEA, 2016; Lacy and Rutqvist, 2015; McDonough and Braungart, 2010; Scheel, 2016).

As a first industry organisation to give guidance to firms trying to implement CE in their business, the British Standards Institution presented the standard “BS 8001:2017 – Framework for implementing the principles of the circular economy in organizations” (BSI, 2017). The standard presents CE principles, an implementation framework as well as supporting guidance and is applicable to any organisation, regardless of type, industry, size, or location.

Table 2-4: Circular economy principles in literature

	Andersen (2007)	Bocken et al.(2016)	Brundtland (1987)	BSI (2017)	Ellen MacArthur Foundation (2015a)	European Environment Agency EEA (2016)	Ghisellini et al.(2016)	Kirchherr et al.(2017)	Lacy and Rutqvist (2015)	Lieder and Rashid (2016)	McDonough and Braungart (2010)	Murray et al.(2017)	Rashid et al.(2013)	Scheel (2016)	Stahel (1984)	Upward and Jones (2016)	Yong (2007)
3R Principles in hierarchical order					x	x		x								x	x
Energy must be renewable, natural capital must be used in a regenerative way			x		x			x		x							
Biological and technological material is food and must re-enter biosphere or supply chain	x				x	x			x		x			x			
Materials must be toxic free and kept pure		x			x						x						
Waste is designed out		x		x	x	x	x				x		x				
Maximise resource utilisation and consecutive cycles		x		x	x		x		x		x		x				
Stewardship				x				x				x					
System thinking				x	x							x					
Strive for diversity																	
Local and decentralised production								x						x	x		x
Maintain economic growth								x								x	
True cost and transparent	x			x	x					x							

It is meant as a guidance that provides advice and recommendations with the overarching goal to “create long-term business value by design through the sustainable management of resources in its products and services” (Pauliuk, 2018). Pauliuk, conducted an appraisal of the BSI standard, highlighted the level of detail in the definition and clarification of concepts, the comprehensive approach and definitions, the high level of ambition, the clearly described challenges in the paradigm shift and the disruptive nature as a core strength of the principles presented. However, according to the researcher, the link to sustainability is often implicit and the social dimension and ethical aspects are mentioned, but not sufficiently described. Although the standard adopts the definition of CE developed by the Ellen MacArthur Foundation, the CE goals of restoration and regeneration are according to Pauliuk not explicitly described in the principles presented.

In a CE, waste does not exist. To accomplish SD the use of scarce and finite resources must be minimised, energy must be produced from renewable sources, and natural capital must be used in a regenerative way. The biological material should be allowed to re-enter the biosphere safely for decomposition and to regenerate into new value (Ellen MacArthur Foundation, 2015a; Kirchherr et al., 2017; Lieder and Rashid, 2016).

Technical materials should never be considered waste but be turned into wealth by re-entering it into the supply chain using new technologies and materials. Products can be cascaded across multiple diverse applications along the value chain to avoid leakage of material and destruction of value through loss. By doing so, negative external effects such as landfilling can be turned into possible benefits for both technical components and materials as well as biological nutrients (Ellen MacArthur Foundation, 2015a; European Environment Agency EEA, 2016).

Regenerative biological and restorative technical nutrients must be free of toxic chemicals, strictly segregated and kept pure to increase the collection and redistribution efficiency as well as the material productivity (Bocken et al., 2016; Ellen MacArthur Foundation, 2015a; Murray et al., 2017).

Products and processes must be designed so they not only do less harm but do good and have an optimal product life scenario. Waste is designed out to keep products,

components and materials at the highest utility and value for as long as possible. Such a design can be achieved by determining the EoL strategies not when products have technically failed, but as a precautionary process for disassembly, reuse, and recycling to increase the number of the possible life cycles and optimise the use of the components of a product. Maximising the number of consecutive cycles and extending the utilisation period of products slows down the flow of material through the economic system by avoiding material and energy consumption. This reduced flow of resources can be achieved when companies recognise the responsibility and take on product stewardship and accountability for their products and EoL and continually innovate to achieve efficiency and effectiveness in their products and operations (Bocken et al., 2016; BSI, 2017; Ellen MacArthur Foundation, 2015a; European Environment Agency EEA, 2016; Rashid et al., 2013).

System- and network-thinking is widely applied in CE as organisations, society and the environment are complex systems. These systems are rich in feedback loops and often strongly interlinked with other actors in their system and affected by decisions made by an organisation. These links must be taken into consideration all the time across the entire value chain when planning supply chain networks. Actors in the system collaborate internally and externally through formal and informal arrangements to optimise the economic system and create mutual value (BSI, 2017; Ellen MacArthur Foundation, 2015a; Murray et al., 2017).

CE aims for diversity as a critical driver of versatility and resilience within the systems. Building up robustness through diversity is not only necessary for living systems but as well for economies to recover quickly from various disturbances and crises. Production in CE should be local and decentralised to reduce pollution and resource consumption during transport and create self-sustaining communities and ventures. By doing so, residues and waste from production stay where they have been extracted, processed and transformed (Kirchherr et al., 2017; Yong, 2007).

Business models in a CE must be economically viable and follow the law to ensure economic growth and prosperity are maintained, protected, and strengthened. Prices

should reflect the real costs of a product and all negative externalities must be considered as the price builds a feedback loop and messages to the market. Companies should strive for strongly sustainable business models which create positive environmental, social, and economic value throughout their value creating system, without substituting one with another. To be sustainable, organisations must be transparent about their decisions and activities and communicate them in a clear, accurate, timely, honest and complete manner (BSI, 2017; Ellen MacArthur Foundation, 2015a; Kirchherr et al., 2017; Lieder and Rashid, 2016).

2.4 Linking Goals and Practices in Solution Business: An Institutional Theory Perspective

2.4.1 Institutional Theory

Organisations of all forms are in continuous exchange with their social and cultural environment and adopt norms, values, and beliefs of the social system they are embedded in. Institutional Theory provides a non-economic explanation of organisational behaviour and strategies and tries to understand why organisations behave in the way they do (Yang and Su, 2014). Actors in the institutional environment define the institutions which are the ‘rules of the game’ that organisational actors take into account when determining appropriate action and responding to socially constructed beliefs about what constitutes efficient and effective organisational behaviour (Scott, 1995; Suddaby et al., 2013)

Actors within the institutional environment imbue an organisation with legitimacy, the ‘congruence of an organisation with social laws, norms, and values’ (Widmer and Prior, 2019; Wooten and Hoffman, 2017). To be competitive in the market, firms tend to strive for legitimacy while maintaining efficiency and try to align with the rules and expectations imposed on them, while maintaining profitability and competitiveness (Yang and Su, 2014). Corporate legitimacy is critical to the survival of corporations because it is a precondition for the continuous flow of and access to resources such as skilled workforce and investment capital (Deephouse et al., 2017).

Organisations do not need to unconditionally align with the changes in their institutional environment (DiMaggio, 1988), but be institutional entrepreneurs that have an interest in particular institutional arrangements and break away from the existing patterns of behaviour and strive to develop strategies to create new or transform existing institutions (DiMaggio, 1988; Hardy and Maguire, 2017). Organisations oftentimes find themselves in a paradoxical tension, as they are embedded in an institutional field and are subject to the pressures in the institutional environment, while envisioning and adopting institutional practices (Garud et al., 2007; Hardy and Maguire, 2017). These tensions, in the context of the presented research, can occur for manufacturers who are in an industry with predominant traditional PL, and developing new practices, such sustainable PL, and subsequently get others in the system to adopt these practices by constructing rationales for institutional change and forging new inter-actor relationships (Hardy and Maguire, 2017).

2.4.2 Institutional Logics

Institutional logics are used to explore the interrelations between individuals, organisations, and society. They are the “socially constructed, historical patterns of cultural symbols and material practices, including assumptions, values, and beliefs” (Thornton and Ocasio, 2008) that put meaning to, and guide individuals’ and organisations’ daily activities in, decision and sensemaking (Thornton et al., 2012). Institutional logics link individual agency and cognition with the socially constructed institutional practices. By doing so, they offer precision in understanding and predicting individual and organisational behaviour. They are the complicated, experientially constructed, and thereby contingent set of rules, premiums, and sanctions that are influenced by the social context and determine decision-making of individuals and organisations (Scott, 1995; Thornton et al., 2012).

The institutional logics aim at achieving a specific desired state in a society or a group, which is aligned because of a logic grounded in basic values and accepted among enough actors or actors with enough agency to exist so that it has consistency across its normative, regulative and cognitive levels (Edvardsson et al., 2014). Industrial companies name

environmental and social goals in their vision and mission statement (Rattalino, 2018) because adapting sustainable practices in many cases is both compliant with environmental regulations but as well as managers acquiesce to social pressure that renders it ‘required’, ‘expected’, or ‘normal’ in the contexts in which they operate (Higgins et al., 2018). By communicating compliance with a sustainable PL, companies create a social context for sustainable value creation (Edvardsson et al., 2014) as the perceived ViU co-creation is coordinated by institutional arrangements (Vargo and Lusch, 2016).

2.4.3 Ecosystems as Organisational Fields

Organisational fields are a community of actors that partake of a common meaning system and whose participants interact more frequently and fatefully with one another than with actors outside the field and are guided by the logics defined by institutions of the field (Scott, 1995). Individuals and organisations are most often members of multiple organisational fields. This assists them to offer help to identify how social choices are shaped, mediated, and channelled by the institutional environment (Wooten and Hoffman, 2017). Fields are not geographically bound (Wooten and Hoffman, 2017) but comprise organisations that, in the aggregate, constitute a recognised area of institutional life such as manufacturers producing similar products or services, suppliers, and product consumers (DiMaggio and Powell, 1983).

Service-ecosystems as relatively self-contained, self-adjusting systems of resource-integrating actors. Ecosystems are connected by shared institutional arrangements and mutual value creation through service exchange and can be understood as organisational fields (Vargo and Lusch, 2016). These ecosystems have nested and intertwined micro and macro levels (Chandler and Vargo, 2011) with actors that interact across levels (Akaka et al., 2013; Pop et al., 2018). What happens at one level, intended or unintended, effects other levels. Micro-level institutional arrangements are reflected in the practices, but also simultaneously reflected at the macro-level institutional context as values and beliefs (Koskela-Huotari et al., 2016).

The levels of aggregation are not fixed but variable (Frow et al., 2019) and depend on the context. In solution businesses, a workable approach is to define the micro-level as the dyadic interactions between specific resources (e.g. end-user, engineer, software, culture, processes) and at the macro-level as a higher level of aggregation, that is the social context that the resources are embedded in (Akaka et al., 2013; Chandler and Vargo, 2011). Empirically assessing a higher-level construct such as value creation in a social context is difficult, which is why micro foundations such as resources and their integration practice are used to explore and explain the macro-level constructs in an organisational field (Storbacka et al., 2016).

The emergence and change of fields is relevant to research to establish issues and objectives that become interesting and important to the collective of organisations and for organisations to react to changes in their institutional environment. This is required for organisations to understand why they should become part of an organisational field (Fligstein, 2013; Wooten and Hoffman, 2017). With a practice theoretical approach, the macro-oriented view on organisational fields can be overcome (Suddaby et al., 2013). This helps understanding how actors on a micro level make decisions based on their socially constructed environment. This strengthens the argument that organisations and individuals are not simply rational economic actors but respond to social and symbolic pressures (Lawrence et al., 2009; Suddaby et al., 2013).

2.4.4 Resource Integration as Field Level Practice

Resource integration practice and value attribution are shaped and driven by the rules embedded in the institutions involved in the resource integration. These institutions coordinate the institutional arrangements (Edvardsson et al., 2014; Vargo and Lusch, 2016) and allow actors to make sense of other actors' actions (Scott, 1995).

Practices are routinised types of behaviour which include various strategy tools and methods but also more informal mechanisms like rhetoric and are a means of doing that transcend individuals and time periods, rather than static objects or concepts (Jarzabkowski and Spee, 2009; Suddaby et al., 2013). Practices are temporally unfolding

and spatially dispersed. They represent a repository of background coping skills from which actors unconsciously draw to deal with novel as well as previously experienced situations (Schau et al., 2009).

Practice Theory offers a structure to analyse the words and deeds of actors in the service ecosystem, emphasising on the micro-level practices which are inherently social and conducted by the economic agents in collaborative processes (Kohtamäki and Rajala, 2016). The practitioners at an individual level, such as ‘CEO’ or ‘CFO’, or at an aggregate level such as ‘top management’ or ‘engineering’ (Jarzabkowski and Spee, 2009), do the actual work, recognising that each has a unique way of interpreting and engaging with their field of practice based on education and experience (Suddaby et al., 2013).

The use of Practice Theory in the domain of value creation in CS combines institutional work, the specific behaviour used to create, maintain, and change institutions, with the activities within the firm (Kohtamäki and Rajala, 2016). Practices foster learning and reflection that may drive changes to behaviours and sensemaking, which may in turn create new practices and transform social structures and institutional logics (Skålén and Edvardsson, 2016). With a practice theoretical approach to Institutional Theory, institutions are no longer regarded as ‘things’ that are controlled and populated by the individuals creating them, but as contingent outcomes of ongoing interactions and inter-subjective interpretations of the individuals that they are constituted of (Suddaby et al., 2013)

2.4.5 Institutional Pluralism

Institutional pluralism is the result of multiple institutional logics present in a field such as a service-ecosystem. This pluralism can lead to synergies and complexity between logics as depicted in Figure 2-3. The figure shows the possible results of multiple logics and how this plurality manifests in the business practice of solution businesses.

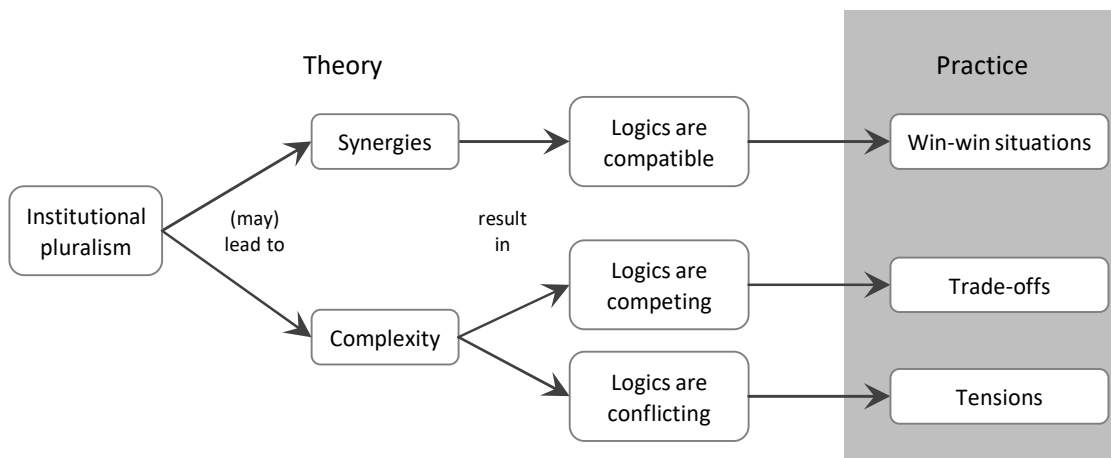


Figure 2-3: Institutional pluralism (based on Greenwood et al. (2011), de Burgos-Jiménez et al. (2013) and Wannags and Gold (2020))

When managing CS in a service ecosystem, complexity becomes a challenge. Complexity usually refers to an attribution of a system of elements, describing how socio-technical systems are complex if they are made up of a large number of parts that interact in a complex way (Bode and Wagner, 2015; Jacobs and Swink, 2011). CS as systems are deemed to be complex because they are made up of a multiplicity of diverse, interrelated elements (Jacobs and Swink, 2011) and the variety of forms in the design of the products, organisation, and supply chains. Multiplicity refers to a larger number of elements, including redundant and replicated elements, while diversity is reflected in the degree of differences across elements in terms of their attributes, and interrelatedness refers to the common or interacting functions embodied in the elements of the CS. In CS, complexity is increased due to the large numbers of functions and components of the assets, activities geographies, occupational specialities and services offered, types of suppliers and their interactions and the rate at which products in the portfolio are replaced as well as the heterogeneity and range of an organisation's activities and the interdependence of technologies (Jacobs and Swink, 2011).

CS are complex during the product-service transition, given the technological complexity involved in high-cost, engineering-intensive products. These spring from high numbers of customised components, the breadth of the knowledge and skills required involved in

the development of the CS, and social aspects along the transformation journey with the contextually determined use variety and customer goals to achieve (Smith et al., 2014).

In the context of institutional logics, the presence of a multitude of heterogeneous actors and factors that are interconnected lead to uncertainty and difficulties for actors to understand the logics and practices of fields. Actors lacking the attention and knowledge to comply with the logics of the field may be ignorant about the exact nature of a field. They may not know about cause-and-effect relations in the field and are not cognizant of all relevant causes of complexity. This makes them unable to disentangle causes and consequences. Plurality in logics leads to a multiplicity of practices, making it difficult to engage in compliant behaviour when new members to the field observe practice diversity among other actors.

Institutional fields may host a multitude of divergent practices, especially when actors are spread across different geographic regions, cultural contexts, sociopolitical systems, and economic situations. Actors experience difficulties making sense of practice multiplicity and the higher the number of divergent practices encountered in a field, the more difficult it is for new actors to exhaustively understand and compare the merits and limitations of different practices. Ambiguity may be the result, especially when different practices are incompatible, making new members to the field wonder which of the many coexisting practices leads to compliant behaviour (Wijen, 2014).

Synergies between logics are what in business terms is referred to as ‘win-win’ when both economic and environmental benefits can be realised (de Burgos-Jiménez et al., 2013; Doni et al., 2019; Haffar and Searcy, 2017). Complexity requires organisational and individual strategic choices to avoid, resolve, or negotiate these trade-offs and tensions to secure support and ensure survival (Greenwood et al., 2011; Santos and Pache, 2010). Trade-offs and tensions exist between two or more poles, which in the case of Institutional Theory are the logics.

Trade-offs represent specific situations in which to act means to choose either one pole or another because logics are competing. Each decision pathway will neglect one pole completely or partially (Wannags and Gold, 2020) and lead to situations when a sacrifice

is made in one area to obtain benefits in another, with it usually being impossible to optimise them all at once (Haffar and Searcy, 2017).

Tensions form relationships between two poles and are conflicting (Hahn et al., 2018). These poles, when regarded individually, appear reasonable, but when taken together are contrary or contradictory propositions and persist over time (Wannags and Gold, 2020). These competing and conflicting logics foster challenges of external legitimacy and internal conflict that need to be resolved by implementing effective structures at the organisational and field level (Smith and Tracey, 2016). They often manifest within different individuals and groups in organisations, creating tensions as these groups become locked in competition in the face of strategic decisions and individual practices (Besharov and Smith, 2014).

One approach to avoid trade-offs and resolve tensions caused by institutional pluralism reflects in organisations' practices in the ambidexterity of how they manage different logics into a single organisation (Greenwood et al., 2011). Actors have different access to fragments of categorical elements of institutions to apply in novel social situations (Thornton et al., 2012) and purposefully embed multiple, potentially competing and conflicting, logics into one organisation to create new hybrid organisational forms and practices (Dalpiaz et al., 2016; Greenwood et al., 2011; Pache and Santos, 2013). The hybridisation of logics that are relatively compatible and present opportunities for change (Dalpiaz et al., 2016) can successfully secure endorsement by field-level actors and, at the same time, achieve effective performance. Combining and layering different logics into a single organization inspires the development of new practices and reinterpreting elements of both logics that enable the firm to pursue opportunities at the intersection of the fields from which these logics are drawn (Pache and Santos, 2013).

Hybrid arrangements are associated with different outcomes, both in terms of opportunities and in terms of execution and legitimation challenges (Dalpiaz et al., 2016). Incorporating multiple logics requires substantial efforts and resources. It is risky and organisations who fail to deliver expected results and comply with the institutions'

demands need to persuade external audiences with commitments to the preexisting logic's regime (Greenwood et al., 2011).

The nature of institutional demands and their incompatibility can exert pressure on organisations at either the ideological goal or the functional means level. Incompatibility of demands that involve conflict prescribing which goals are legitimate to pursue are expressions of the core system of values and references of organisational constituencies and are, as such, not easily challenged or negotiable. Demands that are harmonious at the level of the goals yet lead to a dispute about the means, the functional strategies, processes, and practices, required to achieve these goals are material and peripheral and, thus, are potentially flexible and negotiable (Pache and Santos, 2013).

The tensions occur from both within or external to the organisation and depending on the internal stakes involved, an organisation's response will be different. Distinguishing the internal representation of institutional demands allows to account for intra-organisational processes that affect organisational responses to institutional pressures.

2.5 Business Logics as Ideal Types

When incorporating logics, organisations create a value system, a consistent set of values, beliefs and corresponding behaviour that can be found at an individual and aggregate level. A value system develops as a reaction to specific environmental challenges and is consisting of temporal, spatial, and societal circumstances. Value systems act as ideal types. They are tools that can be used to interpret cultural meanings and break them down into components. They convey what is essential about a phenomenon through an analytical exaggeration of some of its aspects, and act as abstract models used to gauge the deviation of an empirical observation from the theoretical, pure ideal type (Marrewijk, 2004).

Ideal types are used in research to avoid merely reproducing the already confusing empirical situation, but provide a rich, yet generalisable understanding of the varied processes that shape the observed institutional outcome and offer guidance in the development of constructs, acting as a base for values, practices, and beliefs that are

integral parts of any institutional order (Thornton et al., 2012). Ideal types allow understanding differences between organisations, how different types react to complexity, and then explain differences in organisational responses to identical external changes, even when these organisations are in between the extremes of ideal types and may thus exhibit a combination of processes.

Most organisations are not “pure types” and may instead blend different logics, and to decrease reductionism, ideal type frameworks should be used in concrete organisational settings and must therefore always be based on a thorough empirical analysis of the organisations (Waeger and Weber, 2019). Examples of such research include the exploration of institutional complexity and episodic change in organisational policies (Waeger and Weber, 2019) or explaining the varied nature of multiple institutional logics and their implications on organisations (Besharov and Smith, 2014).

Dominant value systems in organisations will in many cases receive a lot of emphasis within the organisation. However, that does not automatically imply that the related value system is functioning since a particular value system includes and transcends previous ones (Marrewijk and Werre, 2003). In reality, organisations face institutional plurality and several logics may be at least partly competing and at odds with each other, for example, that profit-oriented companies are expected to be socially responsible (Waeger and Weber, 2019).

Competing logics become apparent when an organisation tries to transform one or multiple dominant logics, such as having some products that are produced traditionally and some that are produced sustainably, or some market offerings have a product focus, and some have a service focus. The managerial complexity increases if a manufacturer wants to transform multiple logics, such as part of or the entire business, from a traditional linear product business to a sustainable service-dominant business at the same time. Traditional and sustainable as well as goods and service are conflicting logics. A production logic, however, can be supporting an ML and vice versa. The responses to demands depend upon the prioritisation of competing logics and the effort to bring them in harmony.

The categorical elements identified in Table 2-5 and Table 2-6 in the following subsections describe the ideal types used in this research and comprise and specify the organising principles that shape individual and organisational preferences and interests and represent logics such as cultural symbols and material practices particular to that type. In theory, these elements represent how individuals and organisations, if influenced by any institutional order, are likely to understand their sense of self and identity: that is, who they are, their logics of action, how they act, their vocabularies of motive, and what language is salient (Thornton et al., 2012). Each elemental category represents, in theory, a mutually exclusive alternative to the elemental categories of the opposing institutional orders.

2.5.1 Market Logics Ideal Types

Based on extant literature on value creation in customer solution (Section 2.1) and RI (Section 2.2), Table 2-5 describes the building blocks of a product and a service ML (Widmer and Prior, 2019). The distinction between the two ML is not solely defined by the manufacturers' business model, but by where they see the value of their solutions, whether it is embedded in the product or created in the outcome through use (Green et al., 2017). From an institutional point of view product and service ML, a change from a goods to a service-dominant logic of value creation can be regarded as two competing institutional logics. In a goods-dominant logic, actors understand value embedded in products and services in isolation from their customers, whereas, in a service-dominant logic, actors understand value as co-created and assessed by their customers in their social context (Skålén and Edvardsson, 2016).

The two logics prescribe inherently different relationships with the market, the conceptualisation of value, the role of resources, the required collective skills, and the style of leadership required to succeed. In a product ML of CS, services can therefore be viewed as an extension or add-on of manufacturing with a mindset of a goods-dominant logic in which to achieve an uninterrupted performance of a physical asset, with the aim to ensure operational efficiency of providing a solution to the customer, who is seen as the passive receiver. In contrast, when creating value in a service ML, the customer

changes from being a passive audience that receives products and services, to an active player that is involved in the development of new ViU over the entire lifetime. A service-dominant approach for example not merely focuses on managing or mitigating risks, but also on lessening them through active engagement with the customer. This requires the co-production of which shifts the mindset away from manufacturing towards a service-dominant perspective in which the customers' involvement is in the formation of a company's core offering (Frow et al., 2015; Green et al., 2017).

Table 2-5: Market logics ideal types

Logic	Product market logic Value in the product (embedded)	Service market logic Value-in-use (outcome)
Values	ViU is delivered by the firm and its value proposition has embedded value	ViU is co-created, with the customer as an active participant and contributor to value creation during the use of the offering
Assumptions	Value is objective and produced internally within organisations and embedded in offerings during the production process	Value is subjectively cocreated collaboratively with customers and realised when customers use a firm's offering
Practice for resource strategy	Emphasis on operand resources Service is a bolt-on, and the addition of service contracts is an extension of the firm's manufacturing capability	Emphasis on operant resources All value propositions are inherently focused on outcomes, thus serving the customer across different contexts of use becomes a priority
Sources of legitimacy and sanctions	Customers Failing in satisfying customer needs results in them turning away to the competition	Contracts Non-achievement of agreed performance results in penalties
Governance criteria	Transaction Employees add a predefined value efficiently to standardised products and services during a closed manufacturing production process	Outcome Employees co-create value in collaboration with customers focusing on skills, abilities, and performance of customers and employees to create diversified offerings that make sure that customers realise value through the integration of resources provided by the firm and charged based on the outcome
Metaphor	Value resides atomical within a physical product, created, determined and 'added-on' by the firm.	Value is phenomenologically derived in use, through the mutual integration of both firm and customer resources.
Examples	Value propositions are communicated through advertisement, praising compelling product feature or benefit not offered by the competition and are a one-way offer without dialogue between customer and supplier	Value propositions are co-produced between the customer and supplier with the support of institutions
	Producer is creator of value; customer is destroyer of value through use of the products	Both actors in the dyad are integrating resources to jointly co-create value in a particular social context
	Operand Resources are owned by the firm as inputs to production processes and integrated unilaterally downstream the supply chain from raw material to the end customer	Resources are not, they become valuable in their use and connect actors
	No customer engagement or participation	Bilateral engagement between the customer and the supplier as all actors become resources

2.5.2 Production Logics Ideal Types

Based on extant literature on stewardship practice in Chapter 2.3, Table 2-6 describes the building blocks of a traditional and sustainable PL. Sustainability in CS is difficult to measure empirically, which is why stewardship in micro-foundations such as RI practice is more likely to be examinable (Storbacka et al., 2016). Ecosystem actors' efforts of stewardship practice are evidenced if they proactively embrace CE principles, design and plan a service-ecosystem that reduces resource consumption and pollution in material sourcing, manufacturing, distribution, consumption, and recovery (Kalmykova et al., 2018) to maximise ecosystem functioning and human well-being (Murray et al., 2017). The more mature stewardship in a solution is, the more the production logic resembles a sustainable PL.

This research uses a synthesis of 17 sources that resulted in the 12 CE principles presented in Chapter 2.3.3 which describe stewardship practice in RI and define a sustainable PL. In contrast to the sustainable PL, the traditional PL represents production systems which convert natural resources into waste via production, deplete natural capital and virgin resources, and reduce natural capital through waste and pollution (Murray et al., 2017). Different entities from academia, professional bodies, and governmental initiatives have presented principles and rules for a CE. Many of the examples from the practitioner world can be found for principles around design, as the transition towards a CE is as well a design challenge. Some of the suggested principles inevitably link the firm with the social system and the institutional environment it is embedded in. In these situations, institutional logics act as a sense-making frame to manage complexity, which is essential when partially conflicting institutional arrangements (Koskela-Huotari et al., 2016) or institutional voids exist (Wu and Jia, 2018).

Table 2-6: Production logics ideal types

Logic	Traditional production logic	Sustainable production logic
Values	Continuous economic growth predicated upon continuous intensive energy and resource consumption for own profit and externalising the true costs	Growth is independent of finite stocks of resources, eliminates waste, reduces the flow of material through the economic system and virgin-material consumption based on circular economy principles to preserve resources
Assumptions	Assumes an unlimited amount of resources and a planet with a limitless capacity to assimilate waste created by production and consumption.	Assumes that through innovation, economic growth can be decoupled from the consumption of finite resources.
Practice for resource strategy	Take, make, dispose The system encourages efficiency and ease of consumption at a profitable price	Make, use, return The system is inclusive and restorative and encourages standardisation of components and protocols to encourage repair, recovery, and reuse
Sources of legitimacy and sanctions	Trade associations, shareholders Non-compliance results in a drop of share price	Social movements, governments, customers Non-compliance results in customers turning away and employees not willing to work for them
Governance criteria	Financial profit Based on a competitive transactional market exchange guided by price, cost, revenue, margin to become most profitable and result in best shareholder value	Sustainable development Guided by the triple bottom line, resource conservation and replenishment and based on a collaborative relational multi-stakeholder exchange that protects and restores environmental quality, increases the economic prosperity, and guarantees social equality to the benefit of current and future generations
Metaphor	The world is a machine with parts. Humans can understand, predict, and control. The individual is the centre of the world and can work instrumentally to achieve ever-greater results.	The world is a living system with a metabolism where we have complex relationships in which we are participants, have influence and limited opportunity to understand, therefore we need to review frequently.
Examples	Prices reflect only the company's private costs of production, distribution, sales and externalise costs in search of production cost reduction Point of sale ends most responsibility and forces possession and consumption; turnover is encouraged through planned obsolescence. Promotes global scale production to secure low costs and the market position and ensure economic growth to meet interest payments. Transforms natural and social capital into financial capital via a short-term preference.	Prices reflect the full cost aided by the reduction of externalised costs and internalise costs in the search for quality service, performance, and low risk. Solution business extend responsibility and service becomes the point of sale for users seeking a trouble-free service and access over ownership. Regional and local scales are feasible as value and growth is measured more sophisticatedly in the service provided rather than in the selling of goods. Rebuilds and regenerates natural and social capital on a long-term for the benefit of future financial capital.

2.6 Conceptual Framework and Research Questions

2.6.1 Main Constructs

Multiple changes currently occurring in the way how manufacturing companies do business. On one hand, changes in the ML affect the understanding how value for customers is created. The market logic describes ideal types, differentiating between a product ML and a service ML. A service ML promises to deliver more value to the customer for which manufacturers require to transition from a product sales business to a solution business, so requires a change from a product ML which focuses on mere operational efficiency to a passive customer to a service ML in which manufacturer actively engages with the customer and makes customer involvement a major part of the business model (Baines et al., 2009; Skålen and Edvardsson, 2016). Servitization describes a manufacturing company's transition on a product-to-service continuum (Oliva and Kallenberg, 2003) from a product sales business with a dominant product ML to become a solution provider with a dominant service ML.

On the other hand, the emergence of ideas such as the CE leads to a change in the production logic (PL). The PL describes ideal types of how natural resources are used, differentiating between a traditional PL and a sustainable PL. Manufacturers change their PL from a traditional PL in which they convert natural resources into waste, via production, depletion of natural capital and virgin resources and the reduction of natural capital through waste and pollution (Murray et al., 2017) to a sustainable PL. In a sustainable PL, the actors proactively act sustainably by practising stewardship in the RI. They follow CE principles in their decision making and reduce non-renewable resource consumption and pollution in material sourcing, extend resource life, and reduce leakage of resources as waste (Kalmykova et al., 2018; Ranta et al., 2019).

Since the early 2000s, the idea was put forward that manufacturers can become more sustainable through servitization and pursue both an service ML and sustainable PL for their CS as a means for achieving economic, social, and environmental goals. However, the mechanisms of achieving these multiple goals such as incorporating sustainability

measures to otherwise purely financial logic in supply chains (Sayed et al., 2017) are not yet fully understood and still pose a challenge to their business operations (Edvardsson et al., 2014).

Particularly, there seems to be a dissonance between the two underlying logics of service ML and sustainable PL. As described in 2.1, the academic community of solution business and servitization is traditionally concerned with creating better customer value, whereas the research in product-service systems was primarily concerned with sustainability. Both research streams in essence are concerned with the same thing, which is to add services to products. Research in product-service systems has with a vast majority exclusively used examples of good stewardship practice, to make a case of how adding services to products can be more sustainable. Some studies acknowledge rebound effects, but most studies are, however, biased, and almost suggest a positive correlation between adding services and increasing sustainability.

With the advent of the idea of a CE, business and academia alike were searching for solutions to create win-win situations for both businesses and the environment. Studies started to cross-pollinate and to some extent converge and mix the two bodies of literature based on the assumption that if it has the same ingredients, - products and services, assumptions, and findings of the two bodies of literature are interchangeable. This resulted in only little research challenging that servitization in fact always leads to beneficial sustainable outcomes, or even so, be environmentally more damaging. The problem with the existing knowledge is, that we know that CS can be sustainable, that they can create better customer value than product sales business, but that we don't fully understand the mechanisms of how and under what conditions stewardship practice leads to more customer value.

This research builds on three main constructs CS, RI practice, and sustainable value (Table 2-7). The study further uses Institutional Theory to understand how RI in sustainable CS leads to customer value. The inclusion and exclusion of other management theories is presented in the following section 2.6.2.

Table 2-7: Main constructs

Construct	Quintessence	Problem in literature	Framework components	Author
Customer solutions	In solution businesses, the solution provider together with their business customers combine processes, goods, and services to jointly address the customer's operational and business needs. The aim of such a business model is to develop a customer solution (CS), the marketable offering which describes how more value from these combined products and services is created than from each of the elements separately.	The prevailing research in CS focuses only on economic value and neglects aspects of environmental sustainability. Research considers contextual aspects of value creation, but sustainability is rarely regarded as a context.	Service market logic	Payne et al. (2017), Ulaga and Reinartz (2011), Rabetino et al. (2018), Macdonald et al. (2016).
Sustainable value	A company's goals focus on particular outcomes it wants to achieve which drive and direct the motivation to engage in RI. For sustainable value to be created, achieving economic goals does not suffice, but future generations, society at large and the natural environment need to be protected and treated with care. This can be achieved by practising stewardship in the resource integration.	The majority of research focuses on either economic or environmental value and not how sustainable value, that is economic, social, and environmental value is created simultaneously. Literature on product-service systems talks about sustainability but not sufficiently about customer value.	Sustainable production logic	Khalifa (2004), Gutman (1982), Evans et al. (2017), Hart and Milstein (2003).
Resource integration practice	Actors integrate resources because they are motivated to achieve their multiple goals in accordance with their expectations, needs and capabilities but lack some of the required resources internally. Through cooperative and collaborative processes and interactions between actors with the use of invisible, intangible, and infinite operand resources and acting on visible, tangible, and finite operand resources value is created in a service-ecosystem.	There is a lack in understanding how RI translates into value and achieving goals. The relevance of context and how different practices may compete is underexplored in research in resource integration.	Compatible, competing, conflicting logics	Findsrud et al. (2018), Gummesson and Mele (2010), Tuli et al. (2007), Peters et al. (2014).
Institutional logics	Actors integrate resources to create ViU to achieve their goals. This implies a hierarchically organised value system and an interrelation between RI and ViU. Institutional logics allow better understanding the contradictory practices and beliefs and behaviours in RI practice and value attribution. This is relevant to understand how ViU in a social context and in different fields is created.	Little empirical research exists that tests the theoretical assumption of the interrelationship between practices and value in context.	Linking practices with goal achievement and value assessment	Edvardsson et al. (2014), Thornton et al. (2012)

2.6.2 Use of Management Theories

While developing this research, a variety of different management theories were considered. During the positioning study and literature review, Transaction Cost Theory, Resource-Based Theory, Porterian Market Force Theory, Stakeholder Theory, and Institutional Theory were considered.

2.6.2.1 Branches of Institutional Theory

Institutional logics, as described in Section 2.4.2, offers precision in understanding how individual and organisational behaviour is located in the social context and how it is influenced (Thornton et al., 2012). As described in Section 2.4.3, the research used the idea of institutional fields to describe service ecosystems and institutional isomorphism with Scott's (1995) 'institutional pillar' framework to better define the logics within the field. Each of the three 'pillars of institutions' described can be a basis of legitimacy in its own right. These actors within and outside of the service ecosystem imbue an organisation with legitimacy, the 'congruence of an organisation with social laws, norms, and value' (Wooten and Hoffman, 2017).

Some ideas from Institutional Theory were not considered in this research. The idea of a 'Theory of Fields' (Fligstein, 2013) moves away from the static understanding and isomorphism, towards the emergence and change of fields. Where earlier definitions were centred around organisations with, for example, similar technologies or markets, more recent arguments support the forming of fields around the issues and objectives that become interesting and important to the collective of organisations. In a 'strategic action field', multiple actors group and engage comparatively and competitively with differing resource endowments and vie for advantage (Fligstein, 2013; Wooten and Hoffman, 2017). Although this view of fields may be useful for CS and service ecosystems, it was not considered because the focus is on resource integration and not the field itself.

Organisations exposed to institutional pressures are not only passive to their environment or prisoner to their environmental forces. Organisations can be creative in their institutional environment which is labelled 'Institutional Entrepreneurship' (DiMaggio,

1988; Hardy and Maguire, 2017). These institutional entrepreneurs actively create, challenge, and transform dominant institutions. It often includes creating new relationships as changing deeply embedded norms, values and practices requires more than one actor.

Recently, interest in the ‘paradox of embedded agency’ increased which debates the institutional structure and actors’ agency (Garud et al., 2007; Hardy and Maguire, 2017). The paradox puzzles that if actors are embedded in an institutional field and subject to its regulative, normative, and cultural-cognitive pressures that structure their cognition in the institutional environment they are embedded in, how do these institutional entrepreneurs envision and adopt new institutional practices?

Research in ‘Institutional Work’ (Lawrence et al., 2009) refers to the activities that organisations engage in to influence or shape the dominant institutions in their environment in order to gain legitimacy and conform to the norms and expectations of their stakeholders. It is focused on aligning the organisation with its environment and reducing tensions or inconsistencies between the two. Both institutional work and institutional entrepreneurship are widely established ideas in Institutional Theory, but they do not favour the aim of this research, as they are both about the change of and alignment within institutions.

To better understand successful resource integration in solution business, ideas from Practice Theory were adopted to underline the social nature of practices (Edvardsson et al., 2014; Kohtamäki and Rajala, 2016). Practice Theory offers a structure to analyse ‘the words and deeds’ of all actors in the service ecosystem, emphasising the micro-level practices conducted by the economic agents (Kohtamäki and Rajala, 2016). By doing so it overcomes the macro-oriented focus on the organisational field level (Suddaby et al., 2013) in Institutional Theory.

Institutional and Practice Theory argue that organisations and individuals not simply are rational economic actors, but respond to social and symbolic pressures. Combining institutional and Practice Theory helps in understanding micro-level decision-making by actors based on their socially constructed environment. It bridges the gap between the

micro-level activities of resource integration and the macro-level changes in the organisation's environment.

Integrating the two follows according to Suddaby, Seidl and Lê (2013), two general trends in management research. The first trend is the turn towards more processual understanding of organisations to create more managerially relevant research by being more active. Second, the trend towards a 'practice turn' in social science, describes the emphasis on the wider social context that shapes and is shaped by observable activity. This helps to better understand agency and structure in the micro activities in organisations and their relationship to the organisation's macro environment (Suddaby et al., 2013).

For the value component, the research relied on Perceived Value Theory (Zeithaml, 1988) and Means-End Theory (Gutman, 1982) as described in Section 2.1.1, and service dominant logic (Vargo and Lusch, 2008) for understanding ViU as described in Section 2.1.2. These theories are established in social science and have been widely applied and developed in industrial marketing literature. The choice for those theories was because they reflect how value is socially constructed and the manufacturers and customers are embedded in social systems that coordinate the service exchange and perceptions of value (Edvardsson et al., 2011). In the planning phase of the research, other theories considered were evaluated but not considered appropriate for the research aim because they in a traditional way and focus on the focal firm's perspective and discuss competitive advantage with a main focus on economic profit.

2.6.2.2 Other management theories

Transaction Cost Theory (Williamson, 1989) explains how and why firms engage in transactions with other firms. The theory suggests that firms face costs associated with exchanging goods or services in the market, such as search costs, negotiation costs, monitoring costs, and enforcement costs. For the purposes of this research, as the name suggests, the theory is too focused on transactional economic value whereas this research is interested in the experiential value. This is similar to Utility Theory, which in classical economics describes a consumer's behaviour toward a product or service and how much

s/he is willing to sacrifice for it. The marginal utility of a product or service derives from the satisfaction consumers receive for earning one unit more of a product or service (Bowman and Ambrosini, 2000). These theories presume a value-for-money assessment which is not the aim of this research.

This research followed the idea that value is created through the use by a customer. This is why the Resource-Based Theory of the firm was judged to be not suitable. The theory suggests that an organisation can be regarded as a bundle of resources that are valuable, rare, imperfectly imitable and a company's primary source to create competitive advantage (Bowman and Ambrosini, 2000). Resource-based theory focuses on an organisation's internal resources as the creator of competitive advantage, measured as economic profit. The amount of profit realised is determined by the comparisons the customer makes between the firm's product, their needs and feasible competing offering from other firms as well as the deals made with the resource suppliers (Bowman and Ambrosini, 2000).

The Porterian Market Force view of the market argues that uses the offering as the unit of analysis and the services are perceived as the driver for competitive advantage that distinguishes the firm from its competitors. Although research from this view is still published, the amount of studies using market forces is waning compared to the earlier days of research in customer solutions and servitization. A theory which would be closer to the presented research is the theory of dynamic capabilities. It describes how a company's competitive advantage depends on its capability to adapt, integrate, and reconfigure skills, resources, and functional competencies in a dynamic environment. Operational capabilities describe processes such as service delivery and sales, whereas dynamic capabilities include enabling service deployment, that is managing and organising the servitization transformation of the firm (Eloranta and Turunen, 2015).

In terms of the sustainability of customer solutions, Stakeholder Theory (Donaldson and Preston, 1995) was considered. The theory suggests that a firm's competitive advantage depends on the manager's capabilities to react to the various stakeholder demands and maintain relationships with stakeholder groups (Schenkel et al., 2015). These

stakeholders can include the natural environment as well as future generations. The model describes how a company deals with those groups outside the firm and identifies links between the practice of these relationships to corporate performance. It does so by not only describing cause and effects in existing setups but as well recommending attitudes, structures, and practices that, taken together, constitute stakeholder management. Although basic ideas from Stakeholder Theory were considered when conducting the research, the theory is not focal and was not pursued in favour to focus on a few theoretical constructs.

In the exploration of management theories, a preference emerged for frameworks that extended beyond internal organizational perspectives, such as resource-based or dynamic capabilities. The researcher aimed to discover a theory capable of encompassing a more comprehensive understanding of the external environment's impact on organizational dynamics. An important aspect sought in a management theory was its capacity to establish a meaningful link between the fundamental values held by the organization and their practical implementation in day-to-day operations. This emphasis on aligning values and practices aimed to foster a cohesive and purpose-driven approach to management.

Moreover, a consideration in the selection process was the reliance on quantifiable financial indicators within different management theories such as the Resource-Based View of the firm or Transaction Cost Theory. It was recognized that such approaches may presume the fairness of market prices for resources and potentially overlook the externalization of costs and broader socio-economic implications. The Institutional Logics perspective with elements from Practice Theory and Perceived Value Theory was recognised as the most appropriate to help answer the research question.

2.6.3 A Priori Framework

An a priori construction of analytic categories in the form of a conceptual framework (Figure 2-4) has been developed for the investigation to simplify, organise and highlight what is essential about the phenomena and to constrain the natural and often unconscious

process of observer bias (Thornton et al., 2012). The a priori framework synthesises the relevant elements of the literature in a way to link them to the empirical research.

The conceptual framework is based on the three main constructs of this research presented in 2.6.1, RI, CS, and sustainable value. It outlines a trajectory of change manufacturers must navigate when developing the CS. The framework depicts the relevant categories as ideal types with the ML on the horizontal, and the production logic on the vertical axis. As a manufacturing company shifts from a product to a service ML on the horizontal axis, the logic, and therefore the practice on the vertical axis require change as well towards a sustainable PL to achieve a sustainable CS.

The service ML can be compatible, competing, or conflicting with a sustainable PL. This is the result of institutional pluralism as described in Section 2.4.5 and depicted in Figure 2-3. When the service ML is compatible with the sustainable PL, the solution provider faces little managerial complexity because the RI practices of both logics align. When the service ML is conflicting with the sustainable PL, the solution provider faces tensions that persist and cannot be overcome without significant effort. When the service ML is competing with the sustainable PL, the solution provider faces a trade-off and must choose one over the other logic, but cannot obtain the benefits of both RI practices without significant effort. The dashed line in Figure 2-4 indicates that the solution provider in the case of competing logics has to make a decision in support of or against the sustainable PL.

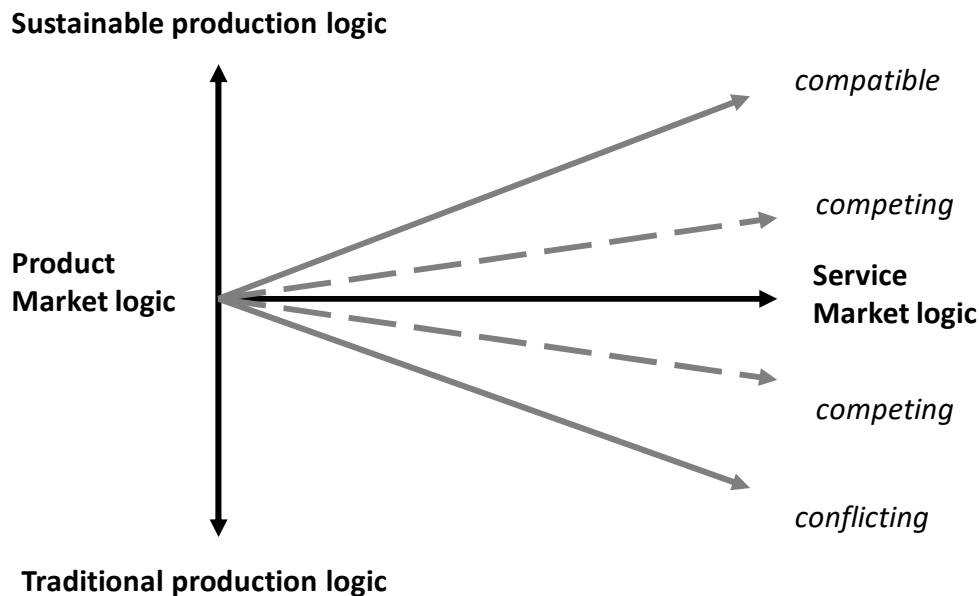


Figure 2-4: Conceptual a priori framework of institutional plurality in solution business

2.6.4 Research questions

Based on the research problem described in Section 1.2, the aim for the research was articulated in Section 1.3. The aim of the research is to better understand the theoretical and managerial aspects of how resource integration in sustainable customer solutions lead to customer value. The main research question therefore asks:

How does resource integration in sustainable customer solutions lead to customer value?

The literature review has revealed two gaps in the current understanding of how manufacturers develop sustainable CS. First, it is not understood under what conditions RI in CS is sustainable. Second, there is a lack of explaining how sustainable value in CS is created. With the aim of better understanding the value creation in sustainable CS in mind, two sub-research questions and respective case studies were developed to operationalise the empirical research (Figure 2-5).

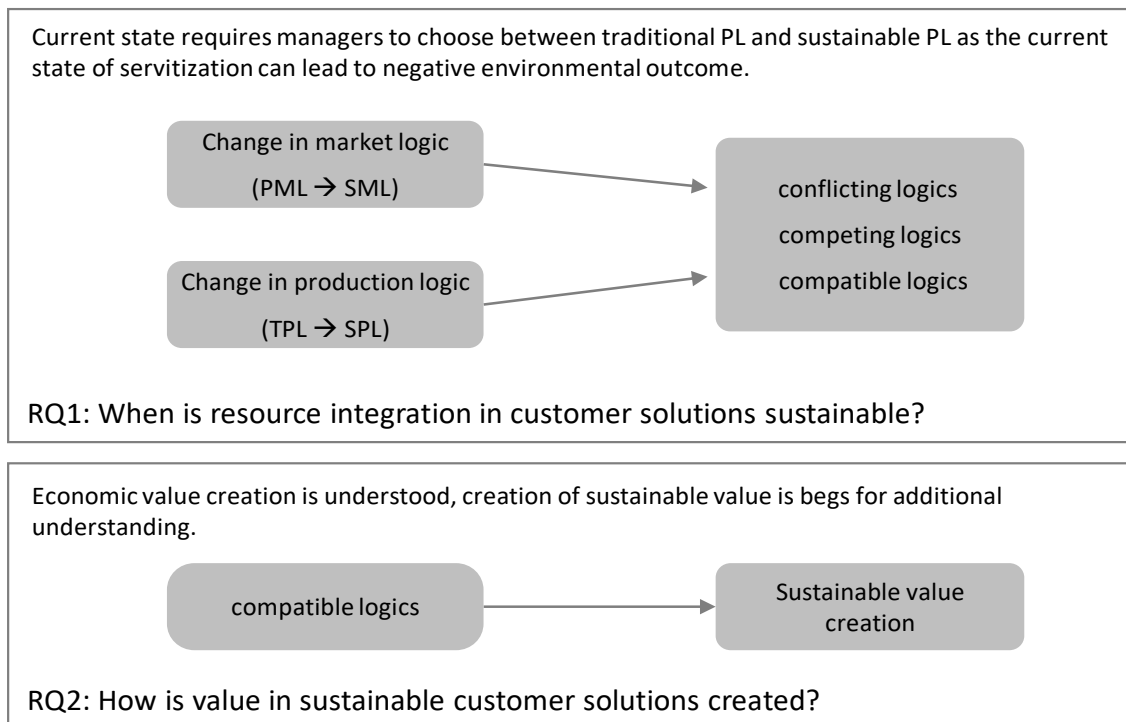


Figure 2-5: Research questions

Empirically assessing a higher-level construct such as change in an organisation's logic is difficult as they are intangible and fuzzy (Suddaby et al., 2013) which is why Storbacka et al. (2016) suggest researching micro foundations such as practices. Resource integration practice is used in both studies to observe what companies and people do. The study uses constructs from Institutional Theory to understand how the institutional environment of a solution provider, through a logics perspective, guides RI practices. Institutional Theory is used to interpret the nature and source of internal and external adaption barriers that hinder, and drivers that enable manufacturers to increase sustainable PL through a change towards service ML.

Firstly, there is a lack of understanding of the conditions which enable manufacturers to align various competing logics. Manufacturers are mainly driven to develop CS so they and their customers can achieve their economic goals. Changing from a product to a service ML requires changes in the RI practices which may be compatible, competing, or conflicting with the RI practices required to achieve social and environmental goals, represented through the sustainable PL. Conditions whereby the logics are compatible,

and manufacturers are more likely to be pursuing the development of the sustainable solutions business (Section 2.3) must be better understood to align service ML and sustainable PL and succeed in sustainable CS. Equally important, conditions in which manufacturers may be faced with competing or even conflicting logics (Section 2.6.5) hinder the development of sustainable CS must be better understood and be easily identifiable. To address this research gap the following research question has been posed:

RQ 1: When is resource integration in customer solutions sustainable?

In a multiple-case study, the inquiry empirically explores from a manufacturer's perspective when servitization increases stewardship (compatible), when servitization is a barrier to increasing stewardship (conflicting) and when manufacturers must choose between servitization or increasing stewardship (competing). In this study, the case is the RI practice in the CS of different manufacturing firms. This study processed the data obtained from 30 of the 43 interviews conducted. The study considers all components identified in the conceptual framework in Figure 2-4. The multiple-case study uses the idea of institutional pluralism to understand the nature and source of internal and external adaption barriers that enable and hinder manufacturers from becoming more sustainable through servitization.

The second gap highlighted in the literature review points towards the lack of understanding of how value for customers in sustainable CS can be created. CS are concerned with the integration and marketing of value propositions, for sustainable CS the customer must be able to create sustainable value from the CS. Customers in sustainable solution businesses aim to achieve economic, social, and environmental goals by integrating resources to create ViU. Manufacturers facilitate ViU creation and meet the customers' needs to achieve their goals by creating value propositions. It is challenging for servitizing manufacturers to understand which resources lead to the achievement of which goals and how these resources must change over time to ensure the continuing creation of ViU as the goals change over time. It is therefore required to understand how resources in sustainable solution businesses can be integrated to create

value propositions that allow the customers to continuously achieve economic, social, and environmental goals by having compatible service ML and sustainable PL. To address this research gap the second research question has been posed:

**RQ 2: How is value in sustainable customer
solutions created?**

The single in-depth case study takes an ecosystem perspective to explore how a solution provider that has sustainability high up on its agenda together with their customer and other actors practice stewardship across the company borders. In this study, the case is the service-ecosystem around a focal manufacturing firm. The study uses means-end chain analysis to identify how the integrated resources lead to the bundling of value propositions and ultimately to the achievement of the manufacturer's and customers' goals. Referencing the conceptual framework presented in Figure 2-4, this study processed the data obtained from 23 of the 43 interviews conducted and is guided by the components in the upper right corner of the conceptual framework where the service ML is compatible with a sustainable PL.

3 METHOD

3.1 Ontological and Epistemological Disposition

Epistemologically, the study is conducted from a social constructionist position and is guided by principles of a naturalistic inquiry (Lincoln and Guba, 1988), which regards interpretivist approaches to research as legitimate. Social constructionists believe in the socially constructed nature of reality, and reject the thought that reality is embedded in pre-existing data, but rather unfolds in an intimate relationship between the researcher and the phenomenon of interest (Erlandson et al., 1993). What is taken to be real is an outcome of a social relation, the social relations between people are therefore intersubjective (Löbner, 2011).

The research is conducted from the viewpoint of an intersubjectivist paradigm. Intersubjectivity implies that knowing is not the individual researcher's endeavour, but that it is socially situated. Knowing cannot exist in a vacuum or an abstract system, nor is it the result of an individual's mind in isolation (Anderson, 2008). The recognition of this delimitation is crucial for the design of the research as it defines how objects and subjects in the research relate to each other (Cunliffe, 2011).

In a naturalistic inquiry, the researcher does not try to detach from the subjects studied, but rather acknowledges that researchers and the researched are invariably influenced by the method of data collection. The researcher conducting a naturalistic inquiry does not believe that reality is deterministic, but that real-world phenomena of interest are socially constructed, constantly changing, and multiple (Erlandson et al., 1993). In a naturalistic inquiry, the researchers do not impose their own views and beliefs upon the subject of study, which implies that no a priori units of outcome are imposed (Wicks, 2010). To ensure that reality is allowed to unfold during the research, abductive reasoning and systematic combining are used to conduct the data collection and analysis (Dubois and Gadde, 2002).

3.2 Research Methodology

In contrast to quantitative research methods, in which the researchers try to minimise or neutralise their presence, qualitative researchers make their position and role transparent. The qualitative researcher is a tool in the research process and acknowledges that with this characterisation, all interpretations and observations are filtered through the researcher's own values and identity (Wicks, 2010). The study uses systematic combining as a constant comparative method and as a constructionist approach to this interpretivist research. Dubois and Gadde (2002, 2014) propose systematic combining as an interpretivist alternative to traditional case research as suggested by Yin (2009) and Eisenhardt (1989) and propose to use abductive, rather than inductive or deductive reasoning. Dubois and Gadde (2002, p. 554) elaborate: "The main characteristic of this approach is a continuous movement between an empirical world and a model world. (...) An abductive approach is more fruitful to discover new relationships and variables, quicker due to the shorter intervals of switching between theory and the real world".

Systematic combining is a process where theoretical framework, empirical fieldwork, and case analysis evolve simultaneously, and it is particularly useful for the development of new theories. These processes influence, and are influenced, by four factors: what is going on in reality, available theories, the case that gradually evolves, and the analytical framework. Learning from a particular case should be considered a strength rather than a weakness. The interaction between a phenomenon and its context is best understood through in-depth case studies.' When conducting systematic combining, the researcher does not rely on one source of data but draws from interviews, observations and other sources of descriptive data, as well as their own subjective experience, to create rich, evocative descriptions of the phenomenon of interest (Armstrong, 2012).

Systematic combining, as suggested by Dubois and Gadde (2002) shares characteristics with an inductive approach. However, the continuous interplay between empirical observation and theory is stressed more than in traditional grounded theory. Systematic combining as a qualitative research method, according to Dubois and Gadde (2002), is

more suitable to develop, rather than test theory, which is what this research does by synthesising elements from Institutional Theory and linking it with Practice Theory.

One difference, as compared with both deductive and inductive studies, is the role of the framework in systematic combining. In studies relying on abduction, the original framework is successively modified, partly as a result of unanticipated empirical findings, but also of theoretical insights gained during the process (Dubois and Gadde, 2002). Systematic combining as Dubois and Gadde (2002) describe it in Figure 3-1 is founded in the process of matching and redirecting, the case, the framework, the empirical world, and the theory.

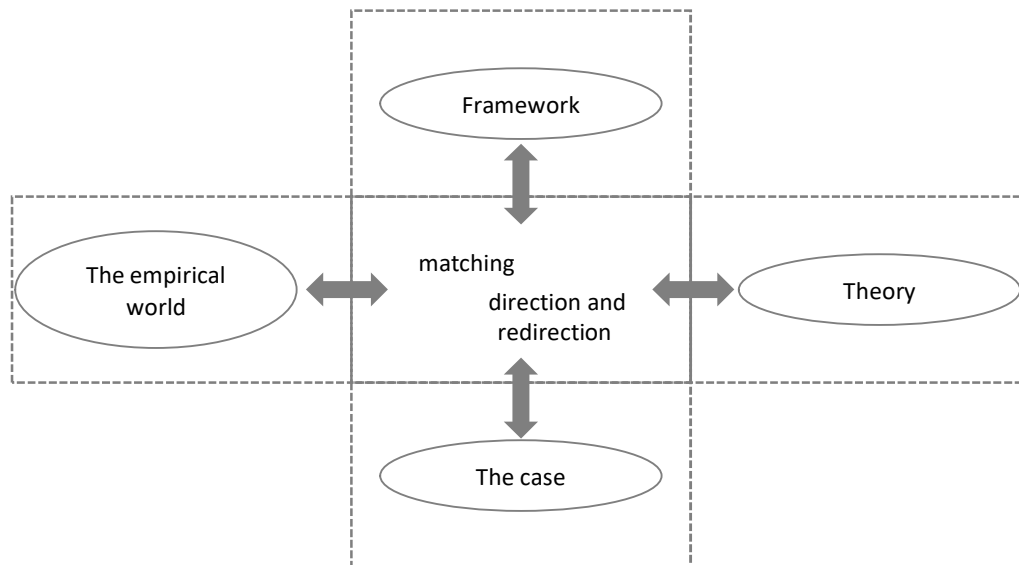


Figure 3-1: Systematic combining from Dubois and Gadde (2002)

Matching describes the process of going back and forth between framework, data sources, and analysis. The process of matching has no obvious pattern, as matching theory and reality can lead in various directions. In this matching process, the researcher directs and redirects the development of the theory using multiple sources of evidence while switching between analysis and interpretation. In traditional case research this is called triangulation (Gray, 2018; Saunders et al., 2016).

While traditional case research uses multiple sources to develop converging lines of inquiry and for verification, in systematic combining the main reason to use different

sources of evidence is to reveal aspects unknown to the researcher. The four elements of systematic combining as described by Dubois and Gadde (2002) are:

Empirical world: Research is time restrained as the processes studied are limited but continue in the real world. A strong in-depth analysis of an individual case in context gains more insight than weak generalisation.

Framework: The framework guiding the research is not tight and prestructured (risk of blinding the researcher to important features in the case or cause misreading of local informants), nor loose and emergent (risk of indiscriminate data collection and data overload). In systematic combining, the framework is tight and evolving to inspire changes of the view of theory and vice versa.

Case: The case is a *tool* to understand the empirical phenomenon of interest which the researcher *sharpens* through the evolving case. It is not possible to fully plan the case in advance. Theoretical language should be saved for the end product, as otherwise the potential contributions through further combining may be constrained.

Theory: The researchers should not be unnecessarily constrained by existing theory, but use systematic combining to develop theory abductively (in contrast to generate inductively or test them deductively).

As described in the previous section, the research was conducted using systematic combining and the constant comparative method (Dubois and Gadde, 2002, 2014; Erlandson et al., 1993).

Given the novelty of the phenomenon of interest, and the many unknowns in the real world, the research conducted was exploratory (Gray, 2018). Exploratory research asks questions of 'what?' and 'how?' and is particularly useful to understand phenomena that are not yet clearly understood, as it is flexible and adaptable to change (Saunders et al., 2016). For the empirical research, a case study design with elements from naturalistic inquiry as a methodology is chosen (Armstrong, 2012). To execute the study, the researchers followed Erlandson et al. (1993) who suggest following steps of sampling,

data collection, analysis, ensuring quality, and disseminating the findings of the naturalistic inquiry:

3.3 Case Selection

This inquiry uses a nonprobability sample design (Daniel, 2012). The constructionist approach of this research refuses random or representative sampling and is not concerned with generalising findings to a broad population. It aims to maximise the discovery of the heterogeneous patterns and problems that occur in a particular context under study (Erlandson et al., 1993). Elements are selected from the target population based on their fit with the purposes of the study and specific inclusion and exclusion criteria and are therefore as well called purposeful sampling (Daniel, 2012; Patton, 2015).

Purposeful selection contributes to deep understanding, enabling the development of new insights and robust theories grounded in data, applicable and generalizable to various contexts (Emmel, 2014; Patton, 2015). Alternatively, theoretical sampling, unlike purposeful sampling, explores and develops emergent theories in qualitative research, aiming to generalize findings. Grounded theory methodology utilizes theoretical sampling to select new participants or cases based on evolving concepts and themes during data analysis. This approach gathers diverse data sources to challenge and enrich the emerging theoretical framework. Theoretical sampling refines concepts concurrently, achieving theoretical saturation (Eisenhardt, 1989; Yin, 2009). Purposeful sampling offers advantages over theoretical sampling in qualitative research. The advantages for this research are, that This approach allows researchers to efficiently target specific individuals or cases directly relevant to the research question, saving time and resources. It also provides access to participants with specialized knowledge or experiences, yielding focused insights. By including diverse perspectives, purposeful sampling enhances the richness of the data.

Research utilizing a naturalistic research paradigm in qualitative management research has used purposeful sampling to investigate a variety of phenomena. Examples include the understanding of supply chain interfaces of freight ports (Demirbas et al., 2014),

internationalization strategies of small- medium-sized enterprises in a specific geographic region (Chandra et al., 2021), or understanding the nature of business communication and its influence on relationships development between buyers and sellers of manufactured goods (Trimarchi and Liesch, 2006). These studies used purposeful sampling to get an in-depth understanding of the interviewees' views and to take their unique experiences and knowledge in their respective contexts into consideration.

The choice was a maximum variability sampling strategy as a sampling procedure that bases the selection criteria on the variability of elements (Patton, 2015). In this sampling procedure, generalisable findings are not of major concern. The use of multiple cases allows for making a statement about the transferability of findings. This strategy aims at capturing and describing the central themes that cut across a great variation of cases. The maximum variation sampling strategy turns that apparent weakness of a small number of cases into a strength by applying the following logic: Any common patterns that emerge from great variation are of particular interest and value in capturing the core experiences and central, shared dimensions of a setting or phenomenon.

While the evaluation describes the uniqueness of each case, it also looks for common themes across cases. Any such themes take on added importance precisely because they emerge out of great variation (Patton, 2015). Patton (p. 325) describes this as "A theme song emerged from all the scattered noise. That is the power of maximum variation (heterogeneity) sampling". By consciously selecting a small sample of great diversity, it is expected that the data collection and analysis yield two kinds of findings: (1) high-quality, detailed descriptions of each case, which are useful for documenting uniqueness and diversity, and (2) important shared patterns that cut across cases and derive their significance from having emerged out of heterogeneity.

The maximum variation sampling allowed to identify one of the cases as a 'single significant case' (Patton, 2015). The choice was the most sustainable enterprise that practices stewardship to explore its service ecosystem further. This case provides a rich and deep understanding of the subject with its distinct, major dimensions and stand-out

importance in the context studied and offers insights that stand alone without attempting to generalise (Patton, 2015).

Prior to identifying the cases, certain eligibility criteria were defined to establish which companies could be included and excluded from the research. To select the cases using maximum variability, a balance of diversity and homogeneity was sought. The case companies should be similar enough to be in a comparable regulative, cultural, and normative institutional environment, but should be distinct enough to show interesting differences. The selection criteria along which the cases were assessed for their eligibility were their sector, number of employees and revenue, legal form, and headquarters, as well as the importance of servitization and stewardship maturity.

Sector

The sampling was delimited to solution businesses in industrial markets, which implies that selected focal firms needed major manufacturing operations combined with services. Focusing on industrial markets further prescribes normative pressures within that sector. The sampling was not limited to a specific industrial sector but must have natural resource-intensive operations and products, produced in global supply chains. Having companies from different industrial sectors allows to reflect more global trends in society and industry.

Employees and revenue

The companies should be of different economic and physical sizes. Having different sized companies allows to investigate the relevance of lever and agency in their respective service ecosystem. The assumption is, that larger companies have more power in their supply chains. However, it was desired that they are not excessively large so that they would not be in monopoly positions in their markets. Smaller companies, however, may be more agile and adaptable because they lack slowing corporate structure and organisational deadlock.

Headquarters and legal form

The companies should be from the same or comparable countries, for example having the headquarters and some of their production in European high-income countries. If they are from the same geographic region or country, they have comparable coercive pressures due to legal boundaries regarding environmental protection and employee rights. Having the same cultural and legal foundation eventually translates into companies reaping benefits from their pursuit of sustainability such as having better access to the labour and capital market. The ownership structure of the case companies is further interesting, as the owner of a privately owned company may have a different expectation towards profit maximisation and social value creation than a publicly traded company, and employees may prefer one over the other legal form.

Importance of servitization

The companies needed to have existing servitization activities and the intention to increase their servitization efforts. This criterion ensures, that they are heavily reliant on natural resources and stewardship could be practised. The maturity of servitization is a mimetic pressure and was measured against the categorisation of stages on the product-service continuum presented in Table 2-3 in Section 2.1.3.

Stewardship maturity

The case companies should have different levels of maturity in their commitment to stewardship practice as described in Section 2.3.3. The sampling drew upon the BSI (2017) framework for implementing the principles of the CE in organisations which provides an assessment methodology for the maturity of circularity. This acts as both a normative and mimetic pressure. The purpose of having CE maturity as variability was to identify how companies manage the influences of CE over different stages of the implementation of CE principles.

A further criterion was access to data and support offered by companies during the selection process. By selecting the cases of solution businesses along these two variables size and stewardship maturity it is expected to have a broad enough but still coherent dataset to answer the research questions. The three firms which present information-rich

cases of firms manifesting the phenomenon of interest were selected. An overview of the selected cases is given in Table 3-1.

A case history report was written for each of the cases based on a specific servitized component of their value proposition and an in-depth analysis was conducted. The individual cases were then compared and contrasted in the ‘cross-case’ analysis. The categories amongst the different cases were compared and supporting and refuting evidence for all categories is looked for in all cases. This process has the benefit of aggregating the commonalities among cases without losing the situational context and uniqueness of the individual case (Stake, 2006) and allows one to recognise the uniqueness of each case. The themes and cases were analysed bidirectionally, both regarding the prominence of themes in the cases and the utility of the cases for developing the themes.

Table 3-1: Case description

Criteria	CableCo	EVCo	PumpCo
Sector	Electrical components	E-mobility	Process equipment
Employees	4500	150	15'500
Revenue	700 Mio (2019)	n/a	3.4 Bn (2019)
Headquarter	Central Europe	Central Europe	Central Europe
Legal form	Stock listed	Privately owned	Stock listed
Importance of servitization	Mostly product sales business	Sales business with flat fee maintenance contracts	Deeply embedded in the culture
Stewardship maturity from section 2.3.3	Improving: Senior Management commitment and central initiative	Engaged: Sales business with customised maintenance contracts	Basic: Little evidence of interest
Data for both case study	7 In-person interviews 3 Remote interviews 2 Site visits	6 In-person interviews 4 Remote interviews 3 Site visits <i>Additional data for single case study:</i> 9 Remote interviews with customers 3 remote interviews with CE Experts 1 In-person interview with CE expert	3 In-person interviews 7 Remote interviews 2 Site visits
Secondary data	Annual reports, website, internal documents	Internal documents, website	Annual reports, website

3.3.1 CableCo

CableCo is a producer of electric equipment and offers connectivity solutions that combine products from radio frequency, fibre optics and low frequency to create solutions for communication, transportation, and industrial applications. The company looks back on 150 years of manufacturing tradition and is publicly traded since late 1990 and today is producing with a global network of 13 production locations. The company has a variety of sustainability measures and certifications for both their production processes and products.

The profound knowledge of radiofrequency and microwave technologies, sophisticated simulation processes and state-of-the-art test methods enables the company to continually reduce the size of components and the materials used for the products. Even though CableCo. provides complete solutions to its customers, the company faces challenges as its products are high volume/low value and passive elements, which makes monitoring virtually impossible. Stewardship only in 2016 under a new CEO made it on the company's agenda, and interest exists in exploring opportunities to go beyond passive sustainability reporting. However, many of the solutions offered by the company, such as the electrification of vehicles and 5G technology are enablers for more sustainable business models.

3.3.2 EvCo

EVCo is a manufacturer of electric vehicles for personal and professional use that produces, sells, maintains, monitors, and remanufactures three-wheeled light electric vehicles and accessories, predominantly for mail delivery companies. Over the past 20 years, the SME has sold over 22,000 vehicles to different countries such as Germany, Switzerland, Finland, Norway, and Australia. The founder has defined the company's basic objective: To develop products that have a positive impact on people and the environment. The company is ISO 9001 and ISO 14001 certified and is committed to polluting the environment in the production and the use-phase as little as possible.

By offering electric vehicles to the market, the company uses a renewable source of energy and is, compared to traditional solutions based on combustion engines, more sustainable. However, the products the company is producing are resource-intensive, and the batteries pose a challenge in recycling and remanufacturing due to the small purchasing volume and the lack of leverage to integrate with the battery producer.

3.3.3 PumpCo

PumpCo is an industrial engineering and manufacturing firm founded almost 250 years ago. Today it is a publicly traded company with international subsidiaries. Over the centuries, the company was active in different markets such as textile and engine production. Today, PumpCo's core strengths are flow control and applicators. The company specialises in pumping solutions and services for rotating equipment, as well as separation, mixing and application technology.

The company's production and service network spreads in 180 locations across the globe. The company is well aware that a significant part of life cycle energy consumption and emissions originates at the customers' site. Products that help reduce energy consumption and emissions are thus crucial to supporting customers in maintaining their business sustainably. The high investment costs and the close customer integration lends itself to solution business, but stewardship is not yet addressed.

3.4 Data Collection

Multiple sources of primary and secondary data were employed to increase the trustworthiness and validity of the study. The researcher also kept a regular log of field notes and conducted multiple site visits. Secondary data was collected from websites, internal documents and published materials and analysed to build case knowledge, validate findings, and triangulate empirical data. Documents of the secondary data included policy documents that describe institutional pressures from a regulatory perspective (see Table 3-1). The documents included as well internal guidelines to determine how those describe tacit knowledge in RI practice and CE. From the two larger,

publicly traded companies CableCo and PumpCo the data included publicly available documents such as annual- and sustainability reports. In some instances, annual reports from customers were reviewed as well.

The use of secondary data served two purposes. First, the data was used to get a better understanding of the companies to support the development of the data collection protocols. Second, the secondary data was used to triangulate the data set to increase the credibility of the data. The documentary sources were compared with the statements of the interviewees to paint a comprehensive picture of the stewardship practices and see if what the cases claim on documents is taking place in the day-to-day business. Where applicable, the secondary data was used to challenge the respondents' answers, for example when they were not aware of certain regulations or internal guidelines. This triangulation was practised during the entire time of data collection and analysis.

The main source in systematic combining is interviews (Dubois and Gadde, 2002). In intersubjective research, these are what Cunliffe (2011) suggests to be conversations in which participants jointly reflect on issues and discuss insights. The primary source of data is 43 semi-structured interviews with three companies and four sustainability experts which were conducted in 2019 and lasted on average 45-60 minutes. Figure 3-2 depicts how the cases relate to the two sub-research questions, Table 3-2 presents an overview of the interview data. The researcher conducted initial interviews with the representatives from business development and identified further actors through snowballing. The multiple-case study in Chapter 4 based on the interviews with ID starting CA (for CableCo), EV (for EVCo), PU (for PumpCo) whereas the single-case study in Chapter 5 is based on the interviews with ID starting EV (for EVCo), C (for customer), CE (for Circular Economy Expert).

The different research phases in Table 1-1 show the chronological order of these phases with a timeline.

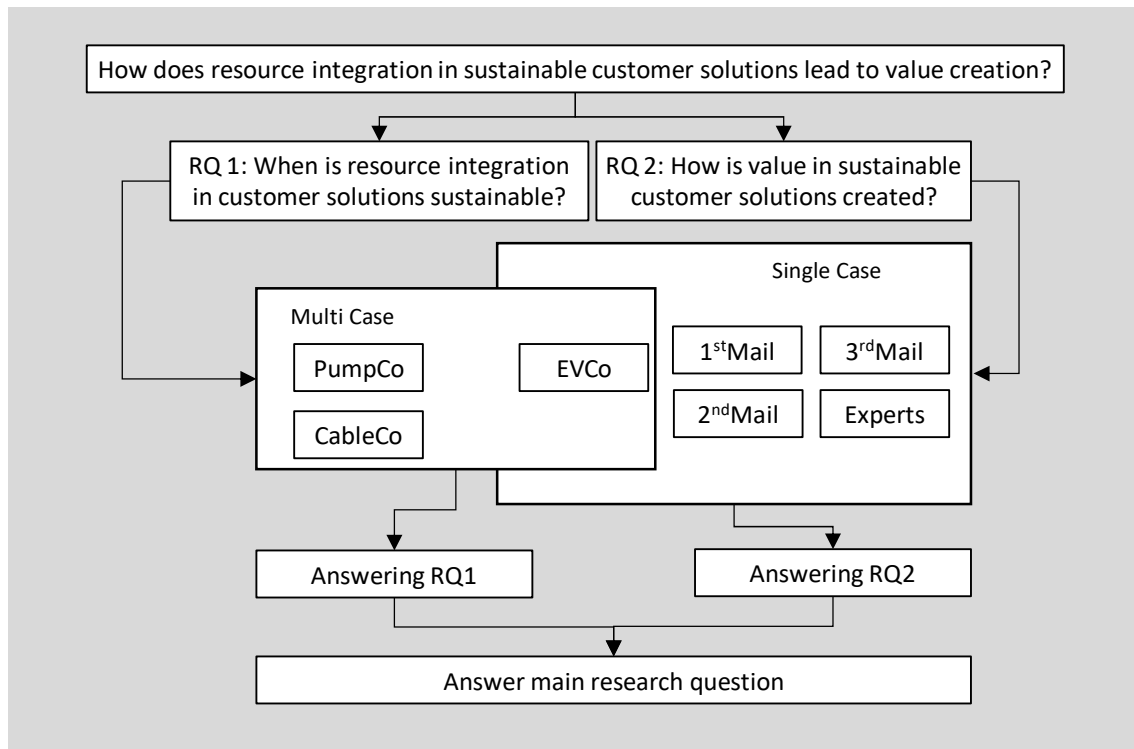


Figure 3-2: Research questions and cases

Interviews were conducted with representatives from marketing, sales, operations, and engineering departments in-person and remotely via Skype for Business. The interviewees held positions such as Head of Sales and Marketing, Sales Manager, Key Account Manager, Head of Service Business, Product Manager, Head of Engineering, Head of Business Development, Chief Operation Officer, or Chief Executive Officers, to represent both strategic and operational insight and capture broad as well as detailed insights of developing and implementing products and services. Overall, the 43 interviews resulted in a total of 36 hours of transcribed interviews.

All the interviews were semi-structured and focused on servitization, firm-specific stewardship practices, and the outcomes of these practices for the case firms, their customers, and stakeholders. The semi-structured interviews are meant to be engaging conversations with interviewees and are guided by a data collection protocol. For each interviewee the protocol with 10-20 questions was adapted to their position and knowledge of the topic and informed by the research questions and the units of analysis.

Exemplary data collection protocols are attached in 7.5 Appendix A. Exemplary questions to the interviewees are:

- How is the value proposition influenced by circular economy?
- How is reducing negative environmental impact linked to measuring the company's performance?
- Could you please explain how you collaborate with your customers when developing solutions?
- What do you learn from your customers and vice versa?
- How do you facilitate the resource integration between the customer and other stakeholders?
- How do you communicate your value propositions to your customers?
- Are there any links or ambitions between increased services reducing resources?
- Do you engage with partners outside the organisation to take on stewardship roles?
- Where are interventions towards reducing resources located within CableCo?

Using a thematic guide and open-ended questions, the interviewees had the opportunity to express their ideas freely and focus on the naturally occurring issues that emerged during the interviews (Miles et al., 2014; Patton, 2015). The interviews took place in multiple rounds, as indicated in the Phase 2-4 in Table 1-1. After each round, the findings were compared against existing servitization and stewardship literature and the Institutional Theory. As the collection proceeded, questions were added and removed, informed by the literature, to sharpen the case. This practice of matching and redirecting (see 3.2) reflects the iterative Grounded Theory method using a process of continuous and systematic combining of theory and empirical data (Dubois and Gadde, 2002).

The notion of time was considered significant in shaping the approach to data collection through temporal framing. The data collection and analysis were not constrained by strict temporal boundaries; however, attention was given to understanding respondents' perspectives in relation to time (Miles et al., 2014). The study aimed to investigate events and experiences that occurred no longer than 5 years before the interviews. The

formulation of questions was designed to elicit insights about recent events, with a focus on instances that took place within the past year of the interviews.

The temporal scope for recounting instances in qualitative management research is subject to a range of considerations, particularly within the context of this specific study. Firstly, industry dynamics play a pivotal role. Some industries undergo rapid transformations, while others maintain relatively stable practices over extended periods. Grasping the dynamic nature of the industry under examination serves as a crucial compass in determining the appropriate reporting timeframe. Additionally, the factor of participant recalls bears weight. Evaluating the participants' capacity to accurately recollect and relay information about events is imperative. In certain instances, recent experiences may be more vividly recalled and recounted, offering a potential influence on the chosen reporting timeframe.

In line with the study's objectives, a prospective horizon of 3-5 years was adopted. This decision stemmed from the observed tendency among interviewed companies to engage in strategic planning cycles of up to five years. This timeframe was deemed appropriate for examining the future trajectories of the industry. Additionally, several crucial factors were considered. For studies involving technology, it's imperative to remain cognizant of potential advancements that could wield transformative influence. These advancements possess the capacity to significantly reshape the research landscape, potentially impacting the predictions and outcomes. To anticipate and respond to the evolving future, it is essential to be vigilant about potential policy shifts and regulatory alterations. These changes have the potential to exert substantial influence on the phenomena under scrutiny, and should thus be factored into the research design. Understanding the prevailing economic and market forces is indispensable. Recognizing the dynamics at play in the economic and market spheres enables a more nuanced and informed exploration of how these factors may contribute to shaping the future landscape. By taking these factors into account, the study endeavours to construct a robust temporal framework that provides a comprehensive outlook on the phenomena under investigation.

By considering this temporal dimension, the researchers aimed to encapsulate respondents' anticipations and strategic outlooks. The study consciously adopted a cross-sectional design as opposed to a longitudinal one, ensuring that each respondent was interviewed at a specific juncture, thereby providing a snapshot of their current perspectives and experiences. This methodological choice proved instrumental in yielding valuable insights into the respondents' viewpoints, encompassing both retrospective reflections and future-oriented projections, all without necessitating prolonged observation. The snapshot approach in this study captures a moment in time, blending both retrospective and prospective viewpoints to provide a comprehensive understanding of the phenomena in question. This temporal sensitivity not only bolsters the validity of the findings, aligning with the principles of naturalistic inquiry as articulated by Creswell (2000), but also resonates profoundly with Practice Theory. Given that practices are comprised of interdependent activities, a practice can only be comprehensively examined and understood within a specific temporal context, a principle underlined by Schatzki (2012).

Table 3-2: Interviewees

Actor	ID	Position	Date	Format	Duration (hh:mm)
CableCo	CA1	Head Global Sustainability	Jun 2019	In person	00:50
	CA2	Head of Global Sourcing	Sep 2019	In person	01:15
	CA3	Application Engineer	Sep 2019	In person	00:54
	CA4	Head of Market Unit Automotive	Sep 2019	In person	00:50
	CA5	Head of Research & Development	Sep 2019	In person	01:03
	CA6	Market Unit Manager Industrial + Transportation	Sep 2019	In person	00:40
	CA7	Head Product Management & Development	Oct 2019	In person	00:46
	CA8	Head of supply chain	Nov 2019	Remote	00:45*
	CA9	Supply Chain Management Development	Dec 2019	Remote	00:59
	CA10	CFO	Jan 2020	Remote	00:20
EVCo	EV1	CEO and owner	Jul 2019	In person	00:56
	EV2	Head of Administration	Jul 2019	In person	00:25
	EV3	International Sales	Jul 2019	In person	01:01
	EV4	Head of Development	Aug 2019	In person	00:49
	EV5	Project Manager Second Life	Aug 2019	In person	00:34
	EV6	Head of Production	Aug 2019	In person	00:37
	EV7	Contract Manager	Jul 2019	Remote	00:50
	EV8	Managing Director Service	Jul 2019	Remote	00:56
	EV9	Head Fleet Management	Sep 2019	Remote	00:50
	EV10	Project Manager Development (Batteries)	Sep 2019	Remote	00:52
Customer	C1	1 st Mail Fleet manager	Jul 2019	Remote	00:33
	C2	1 st Mail Project management corporate responsibility	Aug 2019	Remote	00:58
	C3	1 st Mail Corp. Environmental Responsibility Specialist	Aug 2019	Remote	00:50
	C4	1 st Mail Sustainable Procurement Specialist	Aug 2019	Remote	01:07
	C5	1 st Mail Director of Corporate Sustainability	Nov 2019	Remote	00:34
	C6	1 st Mail Business Solutions Advisor	Dec 2019	Remote	01:09
	C7	2 nd Mail General manager Network Operations	Dec 2019	Remote	00:54
	C8	2 nd Mail VP Strategy and Business Development	Jan 2020	Remote	00:43
	C9	3 rd Mail Asset Manager	Dec 2019	Remote	00:28
PumpCo	PU1	Group Head	Jun 2019	In person	00:41
	PU2	Head of Strategy and Business Development	Aug 2019	In person	00:49
	PU3	Head of Polymer Business	Sep 2019	In person	01:00
	PU4	Product Portfolio Manager	Jul 2019	Remote	00:56
	PU5	Product Portfolio Manager	Jul 2019	Remote	00:52
	PU6	Value Engineering Process Manager	Sep 2019	Remote	00:57
	PU7	Head Product Development and Core Technology	Oct 2019	Remote	01:10
	PU8	Head of Engineering	Nov 2019	Remote	00:43
	PU9	Purchasing manager	Dec 2019	Remote	01:01
	PU10	Head Global Core Technologies and Materials	Jun 2019	Remote	01:07
Expert	CE1	Vice President Supply Chain	May 2019	In person	00:34
	CE2	Director Business Council for Sustainable Development	Jul 2019	Remote	00:52
	CE3	Director Business Council for Sustainable Development	Oct 2019	Remote	00:44
	CE4	Account Executive Sustainability Consultancy	Nov 2019	Remote	01:05

* = Interview CA8 due to technical difficulties not fully recorded, duration estimated

3.5 Data Analysis

As part of the data collection, all interviews were transcribed in vivo and other data such as observations, supplementing documents, and field notes were digitalised and imported into the data analysis software NVivo 12 Plus by QSR International for further analysis. For both case studies the analysis started with a thematic analysis (Section 3.5.1) and an iterative coding process. In the multiple-case study, a cross-case analysis was conducted to compare and contrast the three cases (Section 3.5.2). In the single-case study, a means-end chain analysis was conducted to understand the linkage between resource integration and institutional logics (Section 3.5.3).

3.5.1 Thematic Analysis

The construction of one reality emerges through this ongoing and iterative systematic process. Inductive coding was used as the constant comparison analysis method applied to identify codes emerging from the entire dataset. This method is commonly used when a researcher is interested in utilising an entire dataset to identify underlying themes emerging from the data (Miles et al., 2014). The interactive process data analysis involved data analysis at the research site during the data collection and data analysis away from the site following the data collection and between different sites. The continuous adjustment process in systematic combining and ongoing finetuning between theory and empirical data leads to adjustment during the data collection to ensure the effective collection of rich data that provides a basis for shared constructions of reality.

1st order

In the initial step, the transcribed data was unitised by disaggregating it into the smallest pieces of information that can stand alone. In the next step, the emergent category designation following Lincoln and Guba (1985) involved taking all the units of data and sorting them into categories of ideas. The process of coding allows linking units of data that refer to the same aspect or meaning, or to link aspects or meanings of what was intended to be compared and contrasted.

The approach to coding was guided by the purpose of the research as expressed through the research question and objectives. These ideas were labelled and used for the continuous coding of the data. New pieces of data which had no similar meaning to a previously coded unit of data were devised with a new code. In this process, new categories are likely to emerge as more interviews or observations were conducted and are only finalised once the entire dataset is complete. The initial coding helped developing an in-depth understanding of the cases.

2nd order

In the next step, links and patterns were sought amongst the first-order codes which helped to formulate theoretically distinct second-order categories by combining and aggregating the first-order codes. The analysis involved searching for patterns and relationships in the long list of codes to create a short list of themes that relate to the research questions.

A 2nd order category is a broad theme incorporating several codes that appear to be related to one another and which indicates an idea that is important to the research question. Searching for themes is part of the overall process of condensing the raw data, firstly by coding them and then grouping these coded data into analytic categories (Saunders et al., 2016).

3rd order

Finally, the 2nd order categories were aggregated in 3rd order dimensions. The overarching dimensions were defined to represent the third level of abstraction in the coding to present a theoretically grounded categorisation concerning the research framework. These steps allowed to develop an empirically driven theoretical framework to describe the links between the phenomena that emerged in the data analysis.

The detailed codes of the studies are in the sections 4.2 and 5.2. Table 3-3 shows an exemplary coding structure from the single-case study in chapter 5.

Table 3-3: Exemplary coding in thematic analysis

1st Order Codes Statements that mention....	2nd Order Categories	3rd Order Dimension	Illustrative Quote
rewarding sustainability thinking; Ideology; ownership structure; Do good and talk about it; Sustainability appeals	Company culture	Culture	<i>“Continuous improvement is necessary; what matters is that there is no standing still. It is either progress or regress. That means that if I don't focus on the progress, I fall into regress. That means we are not doing things as we always did, but improvement takes place everywhere and all the time...If products are exceptionally good and last, time can be invested in developing new products, rather than spending it with troubleshooting” [EV3].</i>
Representing country; Customers culture fit	Customer culture		
pragmatic problem solver; Close internal collaboration; Don't see problem but offer solution	Work attitude		

This process of coding and aggregating went through a series of iterations. These built on differences and commonalities between first-order codes, second-order categories, and aggregated dimensions. Informant terms were analysed in-depth to identify possible similarities and differences amongst them, thus discerned the codes for the first-order categories from common words, phrases, and labels that the respondents used. In this way the findings emerged from the data while acknowledging existing theory and the researcher's background. However, another researcher with different objectives may derive different codes from the same data (Saunders et al., 2016).

3.5.2 Cross-Case Analysis

For the cross-case analysis, the codes from the thematic analysis are compared and contrasted to better understand the roots of plurality in CS and focuses on the complexity. Complexity can result in tensions and occur from both within or external to the organisation (Waeger and Weber, 2019). The cause of institutional demands on organisations can be either at the ideological goal or the functional means level (Santos and Pache, 2010). The key distinction is between demands that involve conflict prescribing which goals are legitimate to pursue (which may or may not involve conflict at the means level), and demands that are harmonious at the level of the goals yet lead to a dispute about the means (functional strategies, processes, and practices), required to

achieve these goals. Functional and process demands are material and peripheral and, thus, are potentially flexible and negotiable. In contrast, goals are expressions of the core system of values and references of organisational constituencies and are, as such, not easily challenged or negotiable.

3.5.3 Means-End Chain Analysis

As described in Section 2.4, service ecosystems are organisational fields. In these, the institutional logics describe the values and beliefs within the systems and govern the practices of field members. This suggests a link between the resource integration practice in a CS and the values and beliefs of customers within the ecosystem. Means-end chain analysis was chosen to better understand this link.

The values and beliefs determine which goals customers want to achieve, and which means are legitimate to create ViU in order to achieve these goals. As described in Section 2.1.1, marketing research has long showed interests in how attributes of a solution, such as the integrated resources like products and services, help achieve customers to achieve their goals. This research suggests that there exists a hierarchically organised chain between the attributes of a market offering and the ViU the customers seek (Khalifa, 2004; Sánchez-Fernández and Iniesta-Bonillo, 2007).

The hierarchical chain is conceptualised through three levels as depicted in Figure 3-3 (Mentzer et al., 1997). On a first level are attributes of products, services, and behaviours preferred or sought by customers. In the context of this research, these are the integrated resources. On a second level are benefits which are consequences that result through the use or consumption of attributes. In the context of this research, these are the value propositions. On a third level are values of customers that form a chain of elements which in the context of this research are expressed through ViU. Value is at the highest level of abstraction and determine the decision-making processes of customers (Zeithaml, 1988) (Botschen et al., 1997). In the context of solution business, the method of means-end chain laddering was previously used by Macdonald et al. (2016) to understand how solution quality translates into ViU.

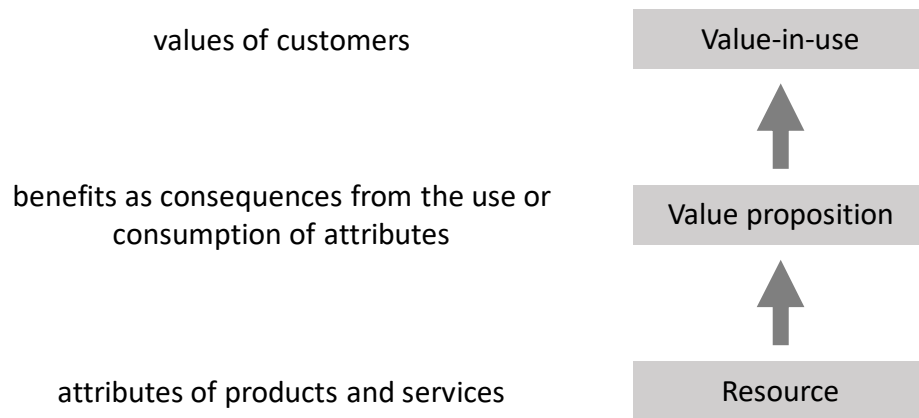


Figure 3-3: Hierarchical means-end chain

As described in Section 3.3, the most sustainable of the three enterprises which practices stewardship the most was chosen as a single significant case (Patton, 2015). This case was further investigated to understand how resource integration as a practice leads to sustainable value. The study used an Association Pattern Technique, which uses two matrices, an attribute-benefit matrix and a benefit-value matrix (Vriens and Ter Hofstede, 2000) to identify means-end chains in the data.

3.6 Research Rigour

Methods from the naturalistic inquiry were followed (Lincoln and Guba, 1988) to ensure the quality of the research. To establish trustworthiness and make a reasonable claim to methodological soundness, techniques such as member checking, peer debriefing, and triangulation to ensure credibility, transferability, dependability, and confirmability were used (Creswell and Miller, 2000; Erlandson et al., 1993).

The aim of a naturalistic inquiry is not to find a representative case from which to generalise findings to other, similar cases, but to develop local and deep understandings of a real-world phenomenon. The researcher is supposed to spend time with the participants and engage in daily activities and conversations to understand their experiences and points of view (Armstrong, 2012). Rather than having a shallow overview, explaining one or more aspects of human behaviour in depth is the goal of analysis in naturalistic research. In a naturalistic inquiry, the research does not try to build

a statistic inference as in positivist approaches to research, which means that academic rigour has to be ensured in different ways (Dubois and Gadde, 2002).

The philosophical and methodological choices determine how the research quality can be assessed. In contrast to quantitative research, in which the criteria for the quality assessment such as reliability and validity are well known, the criteria for scientific rigour and, hence, a believable study, differ in a naturalistic inquiry. In this research, which is guided by intersubjectivity and the assumption that there is no 'one real truth', the interpretation of the quality is key. Various methodologically, theoretically, and empirically derived lists have been developed over the past three decades that assess universal and contingent criteria for qualitative research in particular, as well as general academic practice (Symon and Cassell, 2012).

Lincoln and Guba (1989) presented one of the most prominent sets of quality assessment criteria as an opposing reaction to conventional positivist criteria. Rather than looking for the best fit between interpretation and the one reality, the researcher uses credibility to demonstrate the best fit between the constructed realities of respondents and the reconstructions attributed to them.

To establish trustworthiness and make a reasonable claim to methodological soundness, this research uses the techniques presented in Table 3-4. The four criteria are adopted from Erlandson et al. (1993) and the techniques suggested support the trustworthiness of this research.

Table 3-4: Criteria and examples for ensuring quality

Criterion	Naturalistic Technique	Example/proof
Truth value established through credibility. <i>Conventional Term:</i> <i>Internal validity</i>	Prolonged engagement to be able to claim going beyond superficial observation	The interviews took place over several months with feedback to the main contact which, companies were parallel interviewed to allow comparison during the data collection
	Persistent observation to provide depth by seeking out sources of data	Each company was visited and for each company, interviewees were interviewed in their natural work environment
	Triangulation using different sources of data, methods, and or theories	The inquiry used interviews, online sources, and internal documents
	Referential adequacy materials such as pictures and brochures to support provide context-rich background meaning to support data analysis	Publicly available material such as annual reports and brochures were analysed to understand how the companies portray themselves
	Peer debriefing with other researchers and challenging assumptions	The peer debriefing took place with fellow PhD students, with the supervisory team, and during the PhD progress reviews
Applicability established through transferability <i>Conventional Term:</i> <i>External validity</i>	Member checking (i.e. interviewees) throughout the research process to ensure that the participants' views have been accurately captured	Follow-up calls and emails took place with different interviewees to ensure the statements were interpreted correctly
	Thick description that describes everything that a reader may need to know to understand the findings. This means providing enough information about a context, to facilitate judgments about the extent to which working hypotheses from that context might be transferable to a second and similar context.	The analysis in detail describes the different steps leading to the findings, accompanied by various quotations from interviewees
Consistency established through Dependability <i>Conventional Term:</i> <i>Reliability</i>	Purposeful sampling supports transferability as it focuses not on similarities but case-specific details	The sampling was purposeful, using a maximum variability sampling
	Dependability demonstrates how methodological changes and shifts in constructs have been captured and made available for evaluation by the reader to judge why decisions were made	The research steps and methodology of systematic combining are described
Neutrality established through Confirmability <i>Conventional Term:</i> <i>Objectivity</i>	Confirmability to make clear where the data comes from and how the data was transformed into findings by providing a detailed account of the data collection and analysis process	The conformability is ensured by giving an account on why cases were selected, how interviewees were identified, and how the data was analysed, and findings were synthesised

4 MULTIPLE-CASE STUDY: CONDITIONS FOR SUSTAINABLE CUSTOMER SOLUTIONS

The aim of this multiple-case study is to explore when resource integration (RI) in customer solutions (CS) is sustainable. To identify the preconditions, synergies, and barriers for sustainability, the study relies on the conceptual framework developed in Section 2.6 which describes how the change from a product ML to a service ML can be conflicting, competing, and compatible with a sustainable PL. The framework builds on the idea of institutional pluralism and how this results in managerial complexity. The study identified whether the source of the pluralism is internal or external to the organisation as well as whether the cause for the complexity lies within the means or the goal level and compared these findings among the three cases. Table 4-1 describes a major servitization initiative for each case that is used to portrait the plurality of ensuring sustainability when changing towards a CS.

Table 4-1: Examples of servitized solution component

CableCo	EVCo	PumpCo
<i>Reusable cable reels</i> Traditionally, cables are transported on wooden cable reels which in many cases would be burned as hazardous waste after a single use. CableCo as a first-mover in the industry rolled out reusable plastic rolls that follow a standard and can be used by all market participants. The company is now developing a collection network with a third-party distributor and cable dealer on developing an application for the collection of the cable reels.	<i>2nd life</i> Because of a contractual take-back agreement with their largest customer, the company receives each year about 500 used vehicles which they remanufacture and resell. The batteries used in the EV get incinerated as there is no further circular recovery strategy. The company promotes to reuse them in stationary storages and is developing a recycling process to recover the materials in a small-scale plant	<i>Additive manufacturing</i> PumpCo offers repairs and remanufacturing using 3D laser measuring and additive manufacturing technologies to manufacture spare parts that in many cases would not be available and by doing so give the products a second life.

4.1 Data Analysis Procedure in the Multiple-Case Study

In this study, the case (Patton, 2015) is the RI practice of the servitized value proposition of different manufacturing firms. As described in Section 3.3, this inquiry used a maximum variability sampling strategy, a nonprobability sample design (Daniel, 2012),

as a sampling procedure that bases the selection criteria on the variability of elements. Elements were selected from the target population based on their fit with the purposes of the study and specific inclusion and exclusion criteria and are therefore as well called purposeful sampling (Daniel, 2012; Patton, 2015). The criteria for identifying suitable companies to participate in this research included the maturity of their commitment to stewardship at different levels of the BSI (2017) framework for implementing the principles of the CE, the level of advancement in their CS (Baines and W. Lightfoot, 2009), and the company and industry sizes to have a broad enough but still coherent dataset to answer the research questions.

The main source of data for the case study is 30 of the 43 interviews conducted. The detailed accounts of the interviewees for the companies can be found in Table 3-2 (CableCo CA1-CA10; EVCo EV1-EV10; PumpCo PU1- PU10). As described in Section 3.5, the interviews from the three case companies were triangulated with secondary data such as policy documents and annual reports to increase the trustworthiness and validity of the study. As part of the data collection, all interviews were transcribed in vivo and other data such as observations, supplementing documents, and field notes were digitalised and imported into the data analysis software NVivo 12 Plus by QSR International. In this study, the interpretive analysis took place during the data collection on-site, as ‘within-case’ to develop emergent themes, and as ‘cross-case’ in which the individual cases are contrasted and compared. The qualitative abductive analysis process of the within-case analysis relies on the principle of constant comparison (Erlandson et al., 1993).

A case history was developed for each of the companies to familiarise the researcher with each case before beginning to identify commonalities and differences among the cases. Given the large amount of empirical data, the analysis proceeded in four steps as described in Table 4-2.

In steps 1 and 2 a thematic analysis was conducted as explained in Section 3.5.1 to derive at 1st order codes, 2nd order categories, and 3rd order dimensions. In these steps, open coding was deployed, informed by the extant literature and research question, to identify

the instances of market and production logic in each of the cases (Miles et al., 2014). Text passages were identified, in which respondents mentioned either the RI practice (e.g. “we don’t recycle”) or the values and beliefs (e.g. “customers have no interest in sustainability”).

The coding was conducted using three steps to derive at 1st order codes, 2nd order categories, guided by the 3rd order dimensions which were identified in the literature and conceptualised in the research framework:

1. Disaggregating it into the smallest pieces of information that can stand alone to arrive at 1st order codes.
2. Searching for links and patterns amongst the 1st order codes to formulate theoretically distinct 2nd order categories by combining and aggregating the 1st order codes.
3. Aggregated 2nd order categories guided by 3rd order dimensions to present a theoretically grounded categorisation in relation to the research framework.

Table 4-2: Steps of multiple-case analysis

Steps	Description	Activity
Step 1	Identifying market logics	Coding interviews at instances where interviewees mentioned servitization
Step 2	Identifying production logics	Coding interviews at instances where interviewees mentioned traditional or sustainable production
Step 3	Identifying instances of compatible, competing, conflicting	Identifying sections of interview texts that were coded at both market logics (step 1) and production logics (step 2) and analyse whether servitization lead to less stewardship, more stewardship, or whether a trade-off between servitization and stewardship was required.
Step 4	Conducting cross case analysis based on the source and cause of plurality	In the passages identified in as instances of compatible, competing, and conflicting logics (step 3) the market (step 1) and production (step 2) logics were analysed according to the characteristics of source (internal and/or external) and cause (means and/or goals) and then compared and contrasted across the three cases

In the third step, statements in which both market and production logics were identified using the “AND” query function in NVIVO 12 (e.g., “sustainable production logic” AND “service market logic”) and then described whether in these statements the service ML is conflicting, competing, or compatible with a sustainable PL. In the fourth step, each of the instances of plurality was analysed and described whether the source of plurality is from within the company, or external, and whether it is at the means or the goals level compared and contrasted in the cross-case analysis. These steps allowed the development of empirically driven results to describe the links between the phenomena that emerged in the data analysis.

4.2 Within-case analysis

4.2.1 CableCo

4.2.1.1 CableCo Market Logics

Step 1 of the analysis aims to identify the ML which consist of the product and the service ML as described in Table 4-3. In a product ML, the value for the customer is embedded in the product and realised through sales (Green et al., 2017), whereas in a service ML the value is the outcome of value co-creation in a solution (Edvardsson et al., 2011). In the case of CableCo three categories that characterise the product ML emerged. Those are no customer feedback, confining industry standards, and passive components. As the customer predominantly sells passive components with no electronics into a mass market, they have no possibility to monitor the product and often receive no feedback about their products unless something is not working as it should. Further, as many parts are produced according to industry standards, they are commoditised parts.

In the case of CableCo five categories that characterise the service ML emerged. Those are added service, capabilities, change in customers business models, closeness to customer, and solution development. The two most prominent categories describe the kind of added service and how these solutions are developed. The main added services are the design and supply of entire assemblies, instead of individual parts, which is the traditional

business model. Further, the collection and reuse of cable reels and packing is an added service component. Potential services in the future could include a focus on the outcome instead of the sale of products, as well as monitoring the products throughout their lifetime.

The data suggests that the solution development is in most cases driven by the customer to result in co-developed, tailored solutions which are designed for a specific purpose. By co-developing the solutions, CableCo constantly increases the closeness to the customer. This, in some cases, allowed them to even become a first-tier supplier to a major automotive manufacturer. With changes in their customers' business model in the automotive sector towards more servitized business models, such as pay per mile, CableCo experiences the pressure to increase their service as well. The company experiences tensions in aligning its engineering with its production capabilities.

4.2.1.2 CableCo Production Logics

Step 2 of the analysis aims to identify the PL which consist of the traditional PL and the sustainable PL as described in Table 4-4. A traditional PL, the RI in production systems converts natural resources into waste via production, depletes natural capital and virgin resources, and reduces natural capital through waste and pollution (Murray et al., 2017). Whereas a sustainable PL practices stewardship by following CE principles in the decision making in the chain of reasoning with the aim to stepwise transform from a linear to a CE process (Widmer et al., 2018).

In the case of CableCo four categories that characterise the traditional PL emerged. Those are customer requirement, EoL Strategy, internal culture, and technical aspects. The data suggest that the internal culture mostly is characterised by a traditional mindset. For example, there are no incentives for resource-efficient design or EoL considerations in place, other than just cost savings. This internal culture is mirrored by the market and customers that show no intention to improve the EoL of the products as traditionally EoL vehicles are shredded and materials are recycled. The main customer requirements are functionality, cost, and that they comply with RoHS and REACH standards.

Table 4-3: CableCo market logics

1 st Order Codes Statements that mention....	2 nd Order Categories	3 rd Order Dimension	Illustrative Quote
Only downstream communication Producing parts according to industry standards Producing passive components	No customer feedback Confining industry standards Passive components	Product market logic	<i>We are 95% on 2nd tier and this radar antenna is still a stupid component – behind the stupid components first tiers like Continental, Bosch, just to name a few, they basically put the whole electronics into software in order to be able to get the radar signals processed into object places or into information that the automobile can actually use. [CA6]</i>
Assemblies instead of parts; Design support for customers products; Monitor lifecycle; Outcome focus; Reuse packaging Challenge to be good engineering and mass production Change in customers' business models Closeness to customer Co-develop solutions; Custom tailored solution; Customer driven development; Designed for purpose; Develop solution instead of part	Added service Capabilities Change in customers' business models Closeness to customer Solution development	Service market logic	<i>I would say it is about 90% in reaction to a requirement or need and very often we are involved early on in the requirement specification and that is something that we really like because we can demonstrate our competence and steer our customers in a direction where we can best serve our customers. [CA7]</i>

The presence of a traditional product ML becomes evident, as no respondent could make a clear statement about the EoL of their products. The majority of the respondents confirmed that little interest in the topic exists and that products ‘most likely’ get shredded. The EoL challenges CableCo faces is caused by different technical issues that require the company to work in a traditional product ML. Some of CableCo’s products require a certain amount of virgin material, as otherwise, the quality of the products would not suffice. Further, for the polymer-based products, the company could not yet identify materials that suffice technically and are not based on fossil-based polymers.

In the case of CableCo eight categories that characterise the sustainable PL emerged. Those are customer requirements, external pressure, internal culture, longevity, market, non-Toxic resources, reputation, and resource efficiency. The categories represent both internal and external pressures to a sustainable PL, as well as identifiable stewardship practices (i.e., resource efficiency, longevity, non-toxic resources).

Resource efficiency at different stages of the products' life cycles was mentioned by different respondents. Examples of resource efficiency take place at the design stage (even though predominantly motivated by cost reduction), in the production when scrap material gets reinjected into the production process, and during the use phase when energy is saved, or the better quality allows to use less material. Further, due to optimised and reusable packaging, resources for manufacturing the packaging, storage space and fuel consumption in the distribution are reduced.

CableCo’s products are high quality, which leads to a long product use phase. In the railway sector this can be easily more than 30 years, in the built environment easily more than 50 years. The longevity of products is demanded by customers in the automotive sector. With new business models, such as pay-per-mile, vehicles drive higher distances in a shorter period. This means that a component might no longer exceed the lifetime of the vehicle's traditional use phase. The different industries CableCo supplies in most cases do not formally demand environmental accreditation, but it is expected that a supplier is complying with standards such as ISO14001. CableCo’s customers are overall open to suggestions that follow a sustainable PL. They are however not willing to pay a price

premium for it. Further, in most industries, it is a standard to produce according to RoHS and REACH standards, which in turn reduces the toxicity of the products. As CableCo supplies components for the emerging market of electric vehicles, they supply into a market that in its own right follows sustainable practices due to the decarbonisation of its products.

Due to changes in the senior management, sustainability has a higher priority on the agenda and the company is rolling out a broad corporate social responsibility strategy (CSR). CSR has so far not been practiced in an organised manner, but isolated internal sustainability initiatives take place and departments are measured against certain parameters, such as energy consumption. Two main existing pressures towards a more sustainable PL exist. First, financial institutions increasingly pressure companies such as CableCo to reduce their carbon footprint if they want, for example, good lending conditions. Secondly, reputation as a sustainable company becomes increasingly important when searching for qualified staff as the labour market does not want to work for a company that destroys the planet but ‘does something good’.

Table 4-4: CableCo production logics

1 st Order Codes	Statements that mention....	2 nd Order Categories	3 rd Order Dimension	Illustrative Quote
	Customers and industry prescribe specification; functionality is always prime objective, not EoL; Only cost pressure, no sustainability pressure; Only RohS and REACH free, not disassemblable; REACH, RoHS, Cost, and technical functionality are what is asked by customers; Reel is part of price and part	Customer requirement	Traditional production logic	<i>None of those customers has ever asked us whether a connector that we supply at the end of its lifecycle can be just shaken and it falls into components or something like that. It has never been a required specification. [CA1]</i>
	No interest or knowledge about EoL; EoL vehicles get shredded; Not produced for easy EoL assembly; Not proceed with intended EoL; Not sure what happens at the customer EoL	EoL Strategy		
	Efficient design works against economies of scale; Less cost is the only incentive to reduce material; Little internal culture for environmental design; No incentive for resource efficient design other than cost; no internal guidance on EoL, only technical an economically feasible; Reducing packaging because of cost not environment; Sustainability requirements come from customer, not external; Sustainability KPI are missing	Internal culture		
	Bioplastics lack technical properties; Complex integrated parts; Difficult to identify material at EoL; Difficult to recycle parts; Mix of plastic that cannot be recycled; More recycling material leads to less performance for not sufficient cost savings; Reusable cable reels; Technical limitation to lifetime; Technically not possible produce sustainable	Technical		

Table 4-4: CableCo production logics

1 st Order Codes	Statements that mention....	2 nd Order Categories	3 rd Order Dimension	Illustrative Quote
	Customers' business models require longer lasting products; ISO 14001 is not required but expected; Open for sustainability at same price	Customer requirements	Sustainable production logic	<i>I like the trend that the car is used more often in new sharing business models. It helps us that we have always focused on high quality products with a long lifetime – so instead of using a cheap product they have to replace 2 or 3 times in a product lifetime, the cable can stay there for the rest of the lifetime. [CA5]</i>
	Financial institutions make pressure for carbon and climate	External pressure		
	Company is open to resource efficient ideas; Departments are measured against their energy saving; Internal guidance for environmentally friendly design; New CSR strategy; Small sustainability initiatives take place	Internal culture		
	Financially viable to have longer lasting products; industry demands longevity and safety; long lasting products; supplies to green business	Longevity		
	Industry prohibits certain materials	Market		
	labour market wants to work in sustainable company	Non-Toxic resources		
	Design to cost increases resource efficient design; Recycling in production process takes place; reduce energy use in use phase;	Reputation		
	Reduce resources due to adding services; Reduce resources due to better quality; Reduce storage and transport cost through streamlined packing; Reduce transport volume for same amount of products;	Resource efficiency		
	Reusable cable reels; Reusable packing			

4.2.1.3 Plurality in CableCo

The aim of step 3 is to identify instances where the service ML is compatible, competing, or conflicting with a sustainable PL. If the RI practice of a service ML align with the RI practice of a sustainable PL, the two logics are compatible. If the solution provider has to choose between changing the ML or changing the production logic and there is a trade-off between the two, the logics are competing. If the RI practice of a service ML is incompatible with the RI practice of a sustainable PL and servitization leads to negative environmental outcomes, the two logics are conflicting. Table 4-5 demonstrates instances of compatible, competing, and conflicting logics for case CableCo.

Table 4-5: Plurality of logics in case CableCo

	Description	Illustrative example
Compatible logics	service ML and sustainable PL	Takeback and reuse
Competing logics	Prioritising service ML or sustainable PL	Only feasible if scale allows
Conflicting logics	Only service ML or sustainable PL possible	Reusable, but made from fossil-based polymers

CableCo in many cases co-develops solutions with their customers, a practice that is often identified to increase stewardship practice. In the case of CableCo, however, even though the company engages much with the customers, the EoL strategy and resource efficiency is mostly not a matter of concern as these are not a priority to their customers. Another instance of competing logic is a result of the internal culture of CableCo. The solutions the company develops are often ‘designed to cost’ which means they have to meet certain production cost targets. Due to the challenge of designing cost-efficient parts, the company is well capable to design for resource efficiency. However, they do not do this driven from a sustainable PL motivation, it is solely cost-incentivised.

CableCo uses reusable packing for some of their connectors and as a major servitization initiative has switched all their wooden cable reels to reusable plastic reels. This change from selling cables with one-way reels to reusable reels with a collection system is a

change towards a service ML. This change, however, is not only compatible with a sustainable PL but is as well competing and conflicting, which leads to trade-offs and tensions.

Customers appreciate reusable packing as otherwise, they must dispose of it and in the past, in many cases, this was hazardous waste. Although wood is a renewable source, it needed energy and resource-intensive treatment and, in most cases, they were only used once and then had to be disposed of, - in some countries as hazardous waste. According to the Head of Supply Chain Management Development, the wooden reels were prone to breaking and in case of damage, the reel had to be returned to CableCo'. Because the new plastic cable reels are more durable, they are reusable and are design-optimised to take up less space in transport and storage. Further, because of the increased durability, the reels break less during transport and therefore avoid sending replacement shipments.

“7-8 years ago, we had 2-3 broken reels a day somewhere on the world, now we have maybe 4-5 a year and then in all cases it is the logistic provider's fault that dropped it. It is economically and ecologically the best if you only have to deliver once,- but right.” [CA9].

CableCo has recently launched an online platform with the supplier of the reels, so the supplier in some European areas collects the reels and supplies them back to CableCo. Additional benefits of reusable plastic packing is that it is weather resistant and can be integrated deeper into the customers' operations, as some are dustproof and can be brought into cleanrooms. This describes an instance, in which CableCo's servitization efforts lead to stewardship practice and therefore evidence a sustainable PL.

“What we are now working on is to develop a circular system that allows us to take back the reels from the suppliers and refurbish them, clean them, and maybe replace some parts, and can be reused. So, there we have a goal as well for sustainability, and we tried to create a win-win situation, that is that the customer doesn't have waste, it can be reused, and it is a material that can be, opposed to wood, - can be reused.” [CA9]

CableCo's reusable packaging and reels are high-volume low-value goods, which only makes it economically feasible to collect and return them if a customer has a large enough quantity and is not too remote. Otherwise, reusing or recycling locally is the economically more feasible option. The environmental benefit of reusable packing only pays off if they are actually reused, otherwise it is an unnecessary use of resources and therefore a traditional PL. In this case, the servitized offering indicates an instance in which the traditional and sustainable PL are competing and leading to a trade-off.

"We will build up a collection centre and see what comes back, so then we have 8 European countries in which we have a take-back... The challenge in all of that is that it may not cause too many costs, as the reels are too cheap. If the transport is more expensive than the new value of the reel, the whole thing makes no sense economically and ecologically." [CA9].

A further challenge, as explained by the Head of Global Sourcing, is that the company ships globally, and reusable packing only makes environmental sense when it is reused.

"In the automotive industry we have reusable packing in some cases, in most other applications it is one-way packing as our products are sent somewhere in the world and it would be not able to get the packaging back. If you have a reusable packaging that is not reused, that is environmental nonsense." [CA2].

Further, although good for the environment, a downside of reusable packing or cable reels is that the competition of cable manufacturers or traders can use the reels which reduces CableCo's margin compared to market participants. The data suggests further that the change to plastic reels required high upfront cost which were only justifiable because the overall logistic cost is reduced, but not because of increased stewardship practice.

Although CableCo's reels are reusable and have a much higher lifetime than their wooden predecessors, they are made of non-renewable oil-based polymers. The reels have to last in extreme heat and cold under great strain, which only allows a limited recycling rate in the new reels. The downside of the solution, as explained by the Supply Chain

Development Manager, is that the reusable cable reels are heavily dependent on virgin plastic.

“In the large reels, we have 8-9% recycled material in them to save cost, we can't use too much recycled material as the strength can't be guaranteed and structural integrity is compromised.” [CA9].

Current biopolymers are not technically sufficient and there is no experience in the ageing of these plastics, so CableCo uses established material and is not risking new material.

Table 4-6 gives an overview of the institutional plurality within CableCo and describes the source and cause of CableCo's institutional demands of the production logic when shifting from a product to a service ML, indicated with an “x”. As defined in Section 2.4.5, the cause of institutional demands and their incompatibility can exert pressure on organisations at either the ideological goal or the functional means level. The tensions can further occur from both within or external to the organisation and depending on the internal stakes involved, an organisation's response will be different. For example, taking the first conflict in logics “Cable reels, although reusable, are made from fossil-based polymer.” This instance has an external source, because there are no alternatives available to CableCO and they are dependent of the market. Further, the conflict is at the means level, because they would use a more sustainable alternative if there would one be available, making it an operational, rather than an ideological conflict.

A detailed description of the plurality of the logics represented through the 2nd order codes of SL and PL is given in Appendix C.

Table 4-6: Plurality caused by institutional pluralism in CableCo

Occurrence of plurality	Source		Cause	
	Internal	External	Means	Goal
Conflicting logics				
Cable reels, although reusable, are made from fossil-based polymer. [CA8, CA9]		x	x	
The company engages much in developing components and parts together with the customer, such as antennas and sensors that are then built into the body. As there is no requirement for resource efficiency or EoL scenarios from the customer, these aspects are not taken into consideration in the design. [CA6]		x		x
Although the design is made together with the customer, the EoL is not known as the customer doesn't care. [CA7]		x		x
Competing logics				
Reusable packing needs to be shipped back, otherwise its environmental nonsense [CA2]	x			x
The solutions are designed to cost, that means that resources are reduced to a max but only from a financial viewpoint [CA7]	x	x		x
Compatible logics				
Cable reels are optimised for transport and made from plastic so they can be reused [CA8, CA9]	x		x	
In some cases, the company supplies cables on machine coils that are then directly put into the customers production process. These coils are reusable and are a deeper integration into the customers' supply chains. [CA5]		x	x	
Reusable packing for lathed parts that get shipped back to CableCo. [CA2]	x	x	x	
The development of an actively cooled EV charging cable allows to use less copper to compensate for the currency in the cable. The company has developed the entire unit; a pump, a cooling device, a cable that can transport fluid and the connector which takes them away from being a passive component manufacturer to a solution provider. [CA4, CA5]		x	x	
The change towards a service logic in the automotive industry is beneficial for CableCo who are specialised on high quality cables. The cars in access-based mobility drive much more miles in a shorter time, which means that the components are stressed more. [CA5]		x		x

4.2.2 EVCo

4.2.2.1 EVCo Market Logics

Table 4-7 shows the product and service ML in the case of EVCo. In the case of EVCo three categories that characterise the product ML emerged. Those are a limited service component, no consideration of TCO, and no special servicing because of takeback. EVCo sells all their vehicles. The services are always a separate contract added onto the product sale as the company is too small to add additional value to the customer through advancing their services, such as pay-per-use. The production logic for EVCo further manifests as the vehicles are not serviced any better through their first life, even though they are bought back and remanufactured. From a customer perspective, it is still the case that some countries do not evaluate the TCO in procurement but are primarily interested in the lowest investment cost.

In the case of EVCo 11 categories that characterise the service ML emerged. Customer solutions, customer value, customisation, solution development, service contracts, service operations, fleet management, take back vehicles, remanufacturing, battery lifecycle, and selling 2nd life vehicles. These categories can be broadly differentiated into categories that describe the overall solution (customer solution, customer value, customisation, and solution development, service in the use-phase (service contract, service operation, and fleet management), as well as activities around the end of the first life of the vehicles (take back vehicles, remanufacturing vehicles, battery lifecycle, and sell 2nd life vehicles).

EVCo offers its solutions to three customer segments. These are senior citizens, a sports vehicle, and by far the most important, professional delivery services for business customers as well as an in-house developed fleet management system. The vast majority of EVCo's business customers are fully or part-owned by their respective states and therefore must undergo public tender processes when acquiring a new mail-delivery fleet. For those customers, EVCo develops solutions that are tailored to the customers. Standardised products would lower the cost. This is oftentimes the most crucial component in the tendering process, but addressing the individual customer need for both

the vehicles and the fleet management software is more important, as all customers have specific requirements and the standard vehicle gets adjusted to the local environment, as part of the solution.

The development of new solutions can be initiated internally through observation of the market, but most often requests for new development comes through sales directly from the customer. EVCo resembles more project sales and is closer to a key account and the customers expect technical competency and consultancy at all stages. This differentiates it from traditional product sales. EVCo is a relatively small company, and the different teams are both physically and culturally close together and co-develop solutions with the customers' procurement and fleet management, but most importantly the end-users, the delivery personnel.

EVCo informs their solution development through different channels. In particular, the company has a transparent understanding of the lifecycle cost of vehicles in different environments as they collect the data through their replacement fleet and the service contracts through their service partner network. Through those different aspects of solution development, EVCo can offer solutions that enable their customers to do their job efficiently and safely and in line with the increasing number of regulations that require low-emission vehicles.

EVCo agrees with each customer on the conditions of the maintenance package and the penalties if agreed uptime is not achieved. The company has triadic contracts with the customers and their service partner networks and uses replacement vehicles to ensure uptime to the customer. The contracts usually run for 5-7 years, even though the vehicles would last longer, but once written off it is difficult for the customers to continue using them as they have no book value. With the increasing demand for parcel delivery and ever shorter delivery times, it is increasingly challenging for EVCo to maintain the uptime and the timeframes for maintenance get increasingly shorter.

The company uses their fleet management system as a source of business intelligence. Through monitoring the vehicle and driving behaviour, the company supports customers to use their vehicles as efficiently as possible and informs their service operations on what

work needs to be done. EVCo helps customers abroad to build up a service partner network and only engages in business once they can ensure that their vehicles will be maintained properly. These service partners conduct the repairs and maintenance of the vehicles and log them into EVCo's ERP system, so the company knows at all times which vehicles had which work done. In that process, the service partners must send faulty, replaced parts back to EVCo, who will then inspect and where possible remanufacture them.

EVCo encourages all customers to return their vehicles once they are no longer needed or are written off so they can be remanufactured, or parts can be harvested. With its major customer, EVCo has a buy-back agreement to take the used vehicles back after 7 years. In some countries, there are legal requirements to take products back, in particular batteries, as the distributors of batteries are required to take them back after the EoL. EVCo inspects and assesses the received vehicles and depending on their condition, remanufactures them entirely with the same chassis number or harvests the parts. The vehicles that are fully remanufactured are continued in the ERP system and have full transparency over the entire lifecycle mirrored in the system. If the chassis is beyond repair due to rust damage, the chassis gets recycled, and the parts are reconditioned and used in the maintenance of delivery vehicles as replacement parts.

The remanufactured vehicles are sold in an 'as new' condition with 2 years warranty for 40% of the price of a new vehicle to both private and business customers. The batteries that are recovered from the vehicles have no longer enough capacity for daily long delivery routes but can be used as 2nd life vehicles for senior citizens and after that as stationary energy storage. Once the battery's capacity drops below 50%, it can no longer reliably be used and requires disposal. As part of their remanufacturing operations, EVCo developed a battery recycling process intending to recover the material and sell them and avoid paying recycling fees.

Table 4-7: EVCo market logics

1 st Order Codes	Statements that mention....	2 nd Order Categories	3 rd Order Dimension	Illustrative Quote
	No added value through pay-per-use; Product sales with service add-on	Limited service component	Product market logic	<i>Unfortunately, not all public procurement consider TCO. For example, in Italy or France the vehicle first and foremost has to be low-price in the acquisition. They don't want to know what it costs afterwards, and that the vehicle only lasts for three years is not an issue either as long as it is cheap to buy. [EV7]</i>
	Low acquisition cost over TCO	No consideration of TCO		
	No special servicing because of takeback	No special servicing because of takeback		
	Battery price; Customer preference; Customer segments; New business model for 2 nd life vehicles; Offer solution to problem; Public tender	Customer solutions	Service market logic	<i>No post service buys a standard product, but the base product is standardised and with certain adjustments we can satisfy the customers need. [EV3]</i>
	Battery reuse can be communicated by customer; Ensure performance; No pay per use; Reason to by choose EVCo	Customer Value		
	Customisation over standardisation; Tailored to customer requirement	Customisation		
	Co-development of solutions; Development process; Inform solution development; Initiating development	Solution development		
	Uptime and penalties; Contracts with service partner and customer; Different service levels; Duration of contracts	Service contracts		
	Increasing service with older vehicles; Reusing harvested parts for repairs; Service operations in ERP; Service partner network; Service partners return parts for remanufacturing	Service operations		
	Business intelligence through data; Efficient fleet management; Monitoring driver; Monitoring vehicles	Fleet management		
	Take back condition; Take back from all customers	Take back vehicles		
	Problems in remanufacturing; Remanufacturing process	Remanufacturing		
	2 nd life batteries are not competitive; At some point battery needs recycling; Batteries for private customers after professional delivery; Location of most batteries is known due to contracts; Recycling instead of incinerating; Saturated battery market; Unknown condition of batteries	Battery lifecycle		
	2 nd life vehicle condition; 2 nd life vehicle price; 2 nd life vehicle warranty; 2 nd life vehicle sales channels	Sell 2 nd life vehicles		

4.2.2.2 EVCo Production Logics

Table 4-8 shows the traditional and sustainable PL in the case of EVCo. EVCo's traditional PL forms around the EoL, the use phase of the vehicles, and the end of 1st life of the vehicles. In the case of EVCo, eight traditional PL categories were identified. Those are no interest in sustainability by customer, safety requirements, early replacement of vehicle, maintenance, cost for remanufacturing, battery after 1st life, recycling, and regulation. The most prominent cause of traditional PL at the EoL is that some customers lack interest in sustainability and the need for low investment costs, as opposed to low total lifecycle costs. If there is interest by the customers in sustainability, then it is only that the use of the vehicle and the delivery is low emission and not the production of the vehicles. A more technical reason for traditional PL is that in some cases in the design, resource efficiency needs to be traded off to ensure vehicle safety.

During the use phase of the vehicles, ensuring the uptime of the fleet leads to an increase in resource consumption as EVCo has to work with replacement vehicles and the increasing lack of access to vehicles and repair times leads to replacing rather than repairing vehicles and parts. Interestingly, the vehicles are not maintained better because there is a take-back agreement, but the maintenance is only made to ensure uptime and not the best preservation for a 2nd life. The vehicles would likely last up to 12 years in a first life, but most customers retire the vehicles prematurely after 5-7 years as they cannot be used any longer once they are written off.

At the end of the 1st life, the cost of remanufacturing is a main driver of traditional PL as remanufacturing must be economically viable and in many cases disposing and using new parts is the most profitable. A similar problem exists with the batteries for which recovery and reusing is technically feasible, but economically not viable, as there is no market for 7-year-old batteries because the cost of newly produced batteries has dropped drastically. Batteries, therefore, are most of the time incinerated as storing them for later in-house recycling is not viable. The same traditional PL applies to the ABS plastic cladding of the vehicles. Even though the cladding is of high material purity, they get incinerated and not

recycled as the ingredients to produce new cladding from virgin material, crude oil, is too cheaply available on the market and there is no market for recycled ABS plastic.

The use of 2nd life vehicles is limited as due to regulation, the vehicles must be driven with a motorcycle licence. Even though it would be technically easy to choke the vehicles to a speed that allows driving without a licence and therefore increase the potential customer base, it is not allowed to do so because the chassis number is already registered to a higher speed.

Ten 2nd order categories were identified in the case of EVCo which represents the sustainable PL in terms of sustainability practice and culture, in the use phase of the vehicle as well as at the end of the 1st life of the vehicle. Those ten categories are sustainability, image, sustainable culture, development, use-phase, reuse parts, take back, remanufacturing, 2nd life, and the batteries. Sustainability is overall very important to both EVCo and its customers. EVCo has strict requirements for sustainability and audits all major suppliers at least every 1-3 years and their service partners must comply with certain sustainability standards to be selected. Most of EVCo's customers, in particular larger post companies, have strict sustainability codes of conduct for their suppliers and require proof of environmentally friendly practices and do consider the TCO of their products throughout their lifetime. For EVCo, sustainability is deeply embedded in the company's culture and its management follows a sustainable ideology. This is shown in EVCo's operations when the company consciously chooses to engage in less profitable activities, such as remanufacturing 2nd life vehicles or developing an open-source technology for recycling batteries. These activities come with the benefit of higher margins from new product sales.

For EVCo's employees, it is a major, if not the main reason, to join a sustainable company. The image of a sustainable company is important to both EVCo and its customers. Many of EVCo's customers use electric vehicles as part of their sustainability campaigns as they are non-polluting and for many citizens, the delivery personnel is the main identifier of a post service. The sustainable PL of EVCo shows as well in the development process of the products and services through the internal 'model

maintenance process' with representatives from all divisions to identify shortcomings and improvements to make the vehicles more durable and safer.

EVCo informs the development through different channels such as the data from thousands of vehicles on the street, their fleet management system, and the remanufacturing of the vehicles, which helps the company identify the components that last the least. The company, given the small size and physical and cultural closeness of the different teams, can develop the vehicles with EoL thinking and design for maintenance as the engineers and technicians are in constant exchange.

EVCo's sustainable PL shows during the use phase of the vehicles, as they are a sustainable and low-emission alternative to otherwise polluting petrol scooters. The vehicles have a much better capacity/weight ratio than their petrol counterparts and because the reach on a single charge is much higher, fewer depots are required. This saves further resources to build and maintain those depots. EVCo's business customers value the durability of the vehicles, compared to the previous motor scooters. The vehicles require ten times less maintenance and the lifetime of at least 7 years is significantly higher than the motor scooters 1-3 years of use. Further, with EVCo's fleet management system, it is possible to reduce the energy use in the delivery even further as the software gives feedback to the driver on how to drive more energy efficiently.

During the maintenance of the vehicles, the sustainable PL shows in two ways. First, all the parts that are removed by the service partners must be sent back to EVCo who then inspect, and if possible repair them. The repaired parts as well as the harvested parts from EoL vehicles are in the second instance used in the maintenance of the vehicles, as with the business customers where flat fee maintenance contracts are in place, it is not required to use new parts, the uptime is the only requirement.

The company has a take back policy and vehicles that are returned are part harvested, remanufactured, and professionally disposed. In the remanufacturing process, the vehicles are inspected and tested. If the chassis is rusted through, the chassis is recycled, and the parts are harvested and refurbished. If the chassis can be repaired and reused, the vehicle gets remanufactured with the original chassis number. EVCo is particularly

concerned about the sustainable treatment of the batteries in their vehicles and uses them in different applications before recycling. The state of the art for battery recycling is shredding and thermal recovery, EVCo developed a process to manually dismantle the batteries and recover the individual materials and feed them back into the loop. This is both economically and environmentally interesting as the company otherwise has to pay high fees for the disposal of their batteries.

4.2.2.3 Plurality in EVCo

EVCo takes all vehicles back after the use phase and a major customer has a take-back agreement as part of their solution contract to remanufacture, part harvest or properly dispose of them. Out of these take-back agreements grew the need to develop a program to work with the EoL vehicles, to remanufacture them, if possible, harvest the parts, and develop a solution for the EoL batteries. A major benefit for the company, according to the project manager for the 2nd life vehicles, is that the company has all the service records of the vehicles.

“The remanufactured vehicles are declared as 2nd life which is like a separate status in our ERP system. We have the entire history of the vehicles, what has been replaced during the services, because it has meticulously been tracked and reported by our service partners and I take it from there. If we keep it and remanufacture it, we will continue the records on the same chassis number.” [EV5]

Remanufactured vehicles come with a warranty and cost 40% of the new price and can be sold into different markets. If not, the entire vehicle can be remanufactured, parts are harvested and refurbished and can be used by service partners for replacement used in flat fee contracts. According to the project manager for battery recycling, the batteries can be used in multiple life cycles and cascaded for years, offering compatible logics.

“The idea with the batteries is to have a 1st life in a post vehicle, a 2nd in a remanufactured vehicle, a third in an energy storage, and the 4th would be recycling.” [EV10]

Table 4-8: EVCo production logics

1 st Order Codes	Statements that mention....	2 nd Order Categories	3 rd Order Dimension	Illustrative Quote
	No interest in TCO; No interest in sustainability in co-development; No sustainability requirement in tender; Only sustainable delivery of interest, not production; Resource efficiency is side effect Sustainability traded off for safety Early replacement of vehicle Ensuring uptime; Regular maintenance Cost for battery recovery; Remanufacturing needs to be economically viable No market for battery reuse and recycle; State of the art battery recycling Cladding can't be reused; No recycling of plastic; Not designed for remanufacturing; Rust Hindering regulation	No interest in sustainability by customer Safety requirements Early replacement of vehicle Maintenance Cost for remanufacturing Battery after 1st life Recycling Regulation	Traditional production logic	<i>I would have expected that the plastic that is pure ABS can be reused and repurposed but no one in the market has interest. The exact wording of one plastic manufacturer I approached was "as long as oil is that cheap, forget it. For Europe it is too dirty, and we are not allowed to export it to China". [EV5]</i>
	Cost saving; Procurement; Service partners; Sustainable practice; TCO Showcase 2 nd life; Sustainable delivery Cost for sustainability; Sustainable ideology; Working for sustainable company EoL thinking in development; Informing development; Model maintenance process Driver feedback; Durability; Performance Harvested parts; Parts from maintenance Take back channels; Take back conditions Remanufacturing process 2 nd life condition; 2 nd life price Battery lifecycle; Battery recycling process; Condition of battery	Sustainability Image Sustainable culture Development Use-phase Reuse parts Take back Remanufacturing 2 nd life Battery	Sustainable production logic	<i>Then the batteries return from the customer, they still have a capacity of 75% up to 95%. We test them, and if they are still very good, we use them in a second life vehicle. After the second life vehicle use, they can be used in an energy storage, and the theory says that if the capacity of a battery falls below 50%, it is no longer usable and then recycling comes into play. [EV10]</i>

Even though batteries might no longer be suitable for professional use, they are good enough for private users in a second life as those require shorter reach. In a third life, the batteries can be used in energy storage, and after that be recycled using the in-house developed process.

As part of the solutions with flat-fee maintenance contracts that EVCo has with their customers, the company can use the refurbished parts that they have from EoL vehicles as well as repaired parts that their service partners send to them as faulty and use them in their repair and maintenance work, as the flat-fee contracts required only the ensured uptime and not the use of new parts. Remanufacturing allows saving the energy that has been initially put into producing parts and components and reduces the use of virgin resources. However, the servitization initiative leads to instances where the ML is not only compatible but is as well competing or conflicting with a sustainable PL.

For EVCo, the remanufacturing process has to be economically viable and sustainability and financial performance compete. The company has to set itself a threshold of how little margin it can cope with for its remanufacturing operations, as in most cases, taking new parts would be cheaper than refurbishing them. The most ethical solution must be actively pursued but the manufacturer can only afford stewardship when business is going well, as the margins for remanufactured goods are lower. According to EVCo's CEO and founder, the cheap material prices and high wages require a major trade-off.

"I think about the environment as well but have two operating modes. Either I can afford it and consider the environment, if I can't afford it, I have to cut environmental thinking. For example, the second-life vehicles that come back to us, do we just scrap them? That would be the cheapest. But we remanufacture them on a large scale and try to resell them on a large scale. There is a lot of grey energy in the vehicles, and we can consider a market for people who cannot afford a new expensive vehicle, and we can give them a working vehicle." [EV1].

The economic challenges for example become apparent in the vehicle's batteries. Over the past 5-10 years in which the vehicles were operating, batteries became extremely cheap and there is currently no profitable way of remarketing them. The Chinese supplier of batteries is not interested in working on a solution to recycle or take them back because virgin materials are too cheap, and they don't know the quality of the material. EVCo is developing a process to recycle the batteries on a material level, rather than incinerate them, which is the current practice, and could save on the disposal fee. However, until that process is feasible the batteries are stored. This results in additional cost.

From a customer perspective, the trade-off for resource consumption lies in the required uptime they require. The higher the required uptime, the higher the resource consumption because then EVCo needs to work with more replacement vehicles and the choice in maintenance and repair would in some cases be replacing instead of repairing to save time. A further trade-off for the customer is the duration of the use phase of the vehicles. Although the vehicles last up to 12 years for a first life, most customers choose to only use them for 5-7 years and replace them with newer vehicles.

EVCo's delivery vehicles have ABS plastic cladding, which in the case of their largest customer is coloured in the corporate colours and for the second market needs to be changed to a neutral colour because of intellectual property infringements. The used cladding, although it has a high material purity, gets incinerated because it is contaminated with street grime and virgin material is too cheap and the volume for profitable recycling is too low, indicating clear conflicting logics according to the Project Manager 2nd life.

"I would have expected that the plastic that is pure ABS can be reused and repurposed but no one in the market has interest ... The plastic manufacturers I approached answered: As long as oil is that cheap, forget it. for Europe it is too dirty to recycle, and we are not allowed to export it to China." [EV5]

The manager further notes, that the price of resources is just not high enough to create an incentive to be more sustainable.

“The price of new materials is not yet painfully high enough to take action on the used ABS. So that is not in our power, and we have to play the game and burn it. We could store it, but it makes no sense in the way that we don't know if there ever will be a market.” [EV5].

Other components, such as the wheel hubs, used old designs in which remanufacturing was not considered and now need to be shredded as steel is pressed into aluminium which means that one only learns what is not good for remanufacturing after the first use phase.

Somewhat surprising is that the vehicles, even though they will be bought back and remanufactured, they are not specially maintained to keep up their value during the first life. A further issue is that in some cases the customer has no interest in the environmental sustainability of the production process of the vehicles. If anything, the interest in sustainability in the solution is only during the use-phase, that is the delivery of post. Regulation is a further barrier for EVCo that leads to traditional PL from their remanufacturing, as the vehicles cannot be electronically chocked to a lower driving licence category when remanufactured, even if it would be technically very easy to do.

Through their fleet management system, EVCo can monitor the drivers' behaviour and give feedback for efficient driving to reduce wear and energy consumption. The data collected through the provision of the solution, such driver data, maintenance data, and observation of wear in the remanufacturing process, along with an intense engagement with the customers, allows EVCo to continuously improve the vehicles and the services to increase durability, longevity, and energy efficiency which leads to lower resource consumption for the coming model generations. The largest of EVCo's customers are national postal services, which most of the time fall under public procurement laws. In those public tenders, the customers normally are required to consider the full maintenance and total cost of ownership (TCO). If the TCO is considered, solutions such as EVCo's electric vehicles are winning over low investment cheaper alternatives which most likely leads to the reduction of energy and resources throughout the entire lifecycle.

Table 4-9 describes the EVCo's source and cause of institutional demands of the production logic when shifting from a product to a service ML.

Table 4-9: Plurality caused by institutional pluralism in EVCo

Occurrence of plurality	Source		Cause	
	Internal	External	Means	Goal
Conflicting logics				
Certain parts are not possible to remanufacture because of design or damage. [EV6]	x		x	
EVCo has parts such as plastic, steel, and batteries which they have to recycle or incinerate because there is no market for EoL materials and the virgin materials are too cheap on the market. [EV5, EV10]		x		x
Even though the vehicles are known to be taken back after the first life and remanufactured, they are not serviced any better in the 1 st life. [EV3, EV8]	x			x
Sustainability is never the main driver for a decision to choose EVCo's vehicles, efficiency is the driver – sustainability only a nice side effect. [EV3, EV7, EV9]		x		x
Regulation does not allow to change the initially declared maximum speed of 2 nd life vehicles which reduces the amount of potential customers. [EV5]		x	x	x
Competing logics				
Remanufacturing needs to be economically viable and create no additional cost. [EV5]	x			x
A higher uptime requires more resources and could be traded off for sustainability. [EV3, EV8]	x	x	x	x
Even though the vehicles would last much longer, customers only use them for 5-7 years and replace them for newer ones. [EV3]		x		x
Compatible logics				
Take back agreements with major customers are part of EVCo's CS. This allows to plan and establish remanufacturing operations for the vehicle with respective sales channels and develop the recycling operations for the batteries because the manufacturer knows when and how many vehicles will be returned [EV2, EV3, EV4, EV5, EV6, EV7, EV8, EV10]	x		x	x
The flat-fee service contracts that are part of the solution allows to reuse refurbished parts out of the part-harvesting and the service operations. [EV5, EV8]	x		x	x
Through the fleet monitoring, EVCo's vehicles give feedback to the drivers and reduce energy and wear through efficient driving. [EV9]		x		x
The engagement with the customer, the data from the fleet management and the reports from the service partners allows EVCo to understand their products and use thereof and the customer better. Based on that can improve them to last longer and be more efficient. [EV4]	x		x	x
Most customers are state owned and fall under public procurement in which they have to consider TCO and not the cheapest investment, which leads to less resource consumption due to higher durability and less maintenance [EV1. EV7]		x		x

4.2.3 PumpCo

4.2.3.1 PumpCo Market Logics

Table 4-10 shows the product and service ML in the case of PumpCo. PumpCo's product ML shows seven 2nd order categories which mainly arise from the lack of customer demand but as well from the highly standardised market. These categories are no interest in TCO by EPC, no interest in service, separate service, no wish for supplier integration, standards define products, no service because low value, and product focus in value engineering.

Since the early 2000's, the market has transformed and PumpCo increasingly sells their solutions to EPC-Contractors (Engineering, Procurement, and Construction) who build turnkey plants, and no longer to the end customer. These EPC-Contractors are predominantly interested in low investment costs and not the TCO as they usually hand over the plants to the customer after 2 years of initial operation. The EPC-Contractors usually only have a requirement to use equipment from certain suppliers but are not involved in the aftersales.

PumpCo's aftersales operations are a separate business unit, and the services are sold as an add-on. In the oil and gas sector equipment is normally sold with a warranty, and some customers have no interest in service contracts that go beyond the warranty. For the smaller, low-value pumps which are predominantly made from plastic, PumpCo doesn't offer repairs or service as it is common practice to exchange them at the EoL. Overall, most customers are satisfied with only buying the equipment and don't want to engage in extensive supplier integration as they are afraid of losing control over processes or leakage of sensitive data. For a similar reason, the confidentiality of data, the customers did as well not engage in the value-engineering exercise PumpCo conducted. Value engineering is a process, in which each physical component of a product is assessed and evaluated as to what customer value it creates and how the cost could be reduced. Further, the value engineering process focused on the production of the parts and only considered the after-sales in the periphery.

The market for equipment in the oil and gas industry is highly commoditised by the industry standards such as API Standards (American Petroleum Institute), which need to be considered in the engineering process. The standards define everything from design factors to metallurgies. Given the homogenous market, there is only limited interest in going beyond the standard product guarantee in most of the applications.

PumpCo's service ML manifests in twelve 2nd order categories in all lifecycle stages of their solutions. These categories are customer segments, capabilities, solution development, co-development, customers value, efficiency, reputation, uptime, spare parts, remote monitoring, retrofit, 3rd -party equipment. With their solutions, PumpCo serves different customer segments that range from low-value plastic pumps to standardised pre-engineered products, to fully customised pumps for specialist applications. Their customers have different requirements in terms of service requirements and environmental consciousness. In Europe and North America, the customers require a higher service level as they consider the TCO in their procurement, whereas in developing countries the customers predominantly want the cheapest possible solution that may not necessarily be compliant with the highest standards. The EPC customers predominantly require support in the development of their plants but are not responsible for operating the plant in the long term and therefore are not involved or interested in the maintenance and aftersales.

PumpCo is organised in different divisions to provide the capabilities around their EATS activities (engineering, assembly, testing, and shipping). The company has separate divisions for the development, production, and aftersales services and combines those to support the customers in projects where competitors can't compete. To improve their solutions, PumpCo works closely with their suppliers, in particular the foundries, to achieve the optimal casts for their pumps at the lowest cost. This includes the value engineering process. The over 200-year-old company has long-lasting relationships with many customers and alliance agreements with major petroleum companies to develop new technologies, such as the development of special equipment for subsea operations. The customers value both perceived values from PumpCo's solutions as well as hard KPI's, such as high efficiency, which results in lower energy consumption compared to

the competition and high uptime because of quality engineering and materials. The company likewise positions itself at a higher price for high quality with a great strength in engineering that supports the customer throughout the entire lifetime of their equipment.

During the use phase, PumpCo supports its customers with spare parts and service operations. The company is particularly innovative in developing and using additive and hybrid technologies in which additive manufacturing and milling are combined. With these hybrid technologies, PumpCo aims to reduce lead times of up to 4 months down to a target of 48 hours. With much shorter lead times to produce spare parts, the customers won't have to keep as many spare parts in stock to ensure their operations. Currently, the company is building up the capabilities to ensure the quality of parts. This is challenging, as unified protocols for additive manufacturing are missing and the customers' trust must be built up. A further component of PumpCo's solutions is remote monitoring of their equipment through an IoT solution. With the device and sensors, the operation of the pump is monitored and traced and changes from the optimal performance indicate a malfunction in the pump or a leakage in the piping system. The IoT solution was co-developed in a joint-industry collaboration with a major customer.

Over time, requirements such as the pressure or volume of the pump may change. At the end of a first life, PumpCo retrofits its equipment with new components so that the pump is specified to the new requirements and operates most efficiently. This allows customers to reuse their pumps by replacing the internals or cascading them to other uses. PumpCo does these retrofit and repair operations for their own as well as competitors' 3rd party equipment.

Table 4-10: PumpCo market logics

1 st Order Codes	Statements that mention....	2 nd Order Categories	3 rd Order Dimension	Illustrative Quote
	Pumps are sold to EPC; EPC have no interest in TCO; For EPC pumps only have to last first 2 years; End customer does not tell EPC to use TCO	No interest in TCO by EPC	Product market logic	<i>There is not much in the oil and gas industry where you have a long-term uptime performance guarantee. [PU4]</i>
	Customers have no interest in service and repair; Oil and gas is mainly warranty period not uptime	No interest in service		
	Service is an add-on to the sold products; Service unit is separate business unit	Separate service		
	Customers don't want too much supplier integration; Customers don't want to share operation data; Mostly product selling as customers don't want to lose control	No wish for supplier integration		
	High value pumps defined by standards; Norms have to be considered in all engineering; Norms prescribe which metallurgies to take; Standards leave little room to design; Products in oil and gas are commoditised through standards; Difficult to change standards	Standards define products		
	Low value plastic pumps	No service because low value		
	customers were not involved in value engineering; value engineering only involved production not TCO; Service division only limited involved in value engineering	Product focus in value engineering		

Table 4-10: PumpCo market logics

1st Order Codes Statements that mention....	2nd Order Categories	3rd Order Dimension	Illustrative Quote
Customised casts; Different product types; Environmental consciousness; EPC; Semi standard compliant	Customer segments	Service market logic	<i>Correct and that is our strength – we say yes when often the competition says no - so our strength is making engineered to order solutions for everything including pumps, rotating equipment services, our distillation tower - we say yes and will find a solution to the customer's problems. [PU9]</i>
Different divisions; EATS (Engineering, assembly, testing, and shipping); Service division; Taking on jobs others can't; Technology development	Capabilities		
supplier collaboration; Value engineering	Solution development		
Alliance agreements; Joint-industry-project; Long lasting relationships; Speciality development	Co-development		
Perceived value and KPI; Solution attributes	Customers value		
Energy consumption; Energy efficiency; Limits to efficiency	Efficiency		
Engineering strength; High price for high quality; Relationship throughout lifetime; Supporting customers	Reputation		
Uptime	Uptime		
Challenge in additive; Develop additive manufacturing capability; Forerunner in additive manufacturing; Hybrid approach; Lack of protocols for additive manufacturing; Reduce amount of spare parts; Short lead time	Spare parts		
Co-develop IOT solution; IOT to monitor pumps and pipes; Ownership of IOT data;	Remote monitoring		
Adapt existing equipment; Adjust to changing requirements; Cascading to new use; Not replacing all equipment; Replacing internals of pump	Retrofit		
Repair on 3 rd -party equipment; Retrofit 3 rd -party equipment	3 rd -party equipment		

4.2.3.2 PumpCo Production Logics

Table 4-11 shows the traditional PL and sustainable PL in the case of PumpCo. PumpCo's has different business activities and indicates eight 2nd order categories traditional PL. Those are cost is driver, no market for sustainability, internal sustainability, value engineering, limits to additive manufacturing, properties, recycle, and regulation and standards. The markets in which PumpCo delivers are extremely cost-driven and many customers require the cheapest possible solutions. This puts cost and technical feasibility over sustainability. In particular, when working with EPC contractors, low CAPEX is more important than the lifecycle TCO and OPEX. PumpCo could develop and produce more efficient equipment and has as well technology in its portfolio for carbon capture, but there is no large market for these technologies.

The overall sustainability efforts of PumpCo have suffered through overall lower economic performance and sustainability is currently not an integral part of the business strategy. That sustainability is not deeply embedded in the culture and processes manifests as well in the fact that in their value engineering exercise, the company only regarded financial aspects and no environmental aspects.

From a manufacturing point of view, additive manufacturing could have the potential to reduce the resources needed to produce components. However, for many components, this is questionable as the production of the metal powder and the manufacturing itself requires enormous amounts of energy and much of the powder needs to be remelted, so the thermal requirements to cast or use additive are the same. A further big challenge is currently that the quality of additive manufacturing is not as replicable as with traditional manufacturing and the physical properties of the final part are much different from casting.

As PumpCo's solutions operate in extremely harsh conditions, the components must be dimensioned to account for vibration and abrasion as well as specific safety factors in the development which reduces most of the benefits that would, for example, be given by additive manufacturing. The requirements for special materials and alloys in some cases

as well don't allow to use recycled materials and if recycled materials are used, it is for financial reasons. PumpCo's markets are extremely shaped by industry standards which dictate the design and the manufacturing of the equipment. These standards rarely contain sustainability-relevant parameters and as long as there is no regulatory requirement to produce more sustainable products, both manufacturers and customers won't advance. PumpCo's sustainable PL is represented through eleven 2nd order categories. Those eleven categories are customer interest in sustainability, sustainable technology, development, supplier, norms and regulation, sustainable operations, efficiency, recycling, retrofit, additive manufacturing, and monitoring equipment.

The markets in which the company supplies have different interests in the sustainability of PumpCo's solutions. Customers from North America and Europe have an interest in solutions that have sustainable elements, whereas Asian and Middle Eastern customers normally opt for the solution that only meets the minimum requirements and low cost. In most cases, the beneficial sustainability outcomes of PumpCo's solutions, such as energy and resource efficiency, are spillover effects of initiatives to reduce costs. However, PumpCo as well has equipment in its portfolio to capture carbon out of gases which can be used in negative emission technologies. To continuously improve their solutions, PumpCo has different development divisions to both innovate in the core technologies the company applies as well as the product development of market applications. Although the value engineering the company conducted did not explicitly use environmental sustainability as an indicator, the results led to energy and resource efficiency gains through improved design.

Overall development and innovation towards sustainability are encouraged within PumpCo and are as well recognised in the internal innovation awards the company has. To ensure the quality and longevity of their equipment, PumpCo has an intensive collaboration with their suppliers, in particular foundries, and sets high standards in terms of sustainability and as well audits them every 1-3 years. The biggest driver towards sustainability in PumpCo's business is legislation with which their customers have to comply. PumpCo voluntarily has all their production sites ISO14001 certified.

The company has in their vision to save resources and energy in their operations and recycle all material, and aims to reduce the high energy consumption in their production. This is as well externally assessed through an international sustainability agency. In the use phase of the products, the aftermarket division ensures that the equipment operates optimally and is known to be determined to rather fix faulty equipment instead of replacing it at the first obstacle. While investigating their products' environmental impact, PumpCo calculated that over 99% of the energy consumed by their equipment is in the use phase. PumpCo's equipment is top of the class in terms of energy efficiency in their market and efficiency is a selling argument for the company and a driver for the customers. Through their customised solutions and tailored pump casings, PumpCo can design and manufacture their equipment exactly to the customer's requirements. This results in more efficient equipment. In instances that the customers' requirements towards the equipment change over time, PumpCo replaces relevant components, so the equipment operates at the highest possible efficiency or rebuilds them to be used in a different application.

The company is heavily engaged in developing hybrid manufacturing technologies in which milling on 5-axis machines and additive manufacturing technologies are combined. With these technologies, more complex parts can be manufactured and the lead time to produce them is significantly lower. With shorter lead times, the customers as well as PumpCo don't require as many spare parts in stock to ensure the uptime of the equipment. This reduces the resources bound in the parts and saves the storage space required. For the lower value equipment, PumpCo could license the manufacturing files to reproduce them using additive manufacturing and by doing so increase the lifetime of equipment, which otherwise might be replaced and disposed of. During the use phase, the company further supports their customers to save energy and resources through monitoring of the equipment. The remote monitoring solutions identify when the equipment is not performing efficiently and detects vibrations, upon which the system can be inspected and unnecessary energy use and further damage to the components can be avoided.

Table 4-11: PumpCo production logics

1 st Order Codes	Statements that mention....	2 nd Order Categories	3 rd Order Dimension	Illustrative Quote
	As cheap as possible; EPC want low CAPEX; Technical feasibility and cost over sustainability	Cost is driver	Traditional production logic	<i>To be honest, it is technical feasibility and cost – not sustainability. In a lot of cases, I would say it is costs and technical feasibility and this is also what we hear from our customers. [PU10]</i>
	No interest in carbon capture; No market for more efficient equipment	No market for sustainability		
	Reduced sustainability due to low economic performance; Sustainability not part of business strategy	Internal sustainability		
	Customer request could incorporate environment in value engineering; Value engineering didn't consider environment	Value engineering		
	Additive manufacturing driven by lead time; Challenge to replicate additive manufacturing; No environmental benefit from additive manufacturing	Limits to additive manufacturing		
	Additive manufacturing has different properties; Material required for vibration and abrasion; Safety factors	Properties		
	Recycling only for economic reason; Virgin materials required for special alloys	Recycle		
	Industry standard; No regulatory requirement; Standards dictate	Regulation and standards		

Table 4-11: PumpCo production logics

1st Order Codes Statements that mention....	2nd Order Categories	3rd Order Dimension	Illustrative Quote
Geographic different interest in sustainability	Customer interest in sustainability	Sustainable production logic	<i>Our engineered pumps are still in operation for over 100 years in some cases, so our customers to keep these going as long as possible and in many cases, we will do retrofits – so the core of the pump, the shaft and the impellers will be replaced but the shell, the split case will have welding added to it and will be reused. [PU9]</i>
Carbon capture; Cause of sustainability	Sustainable technology		
Development division; Rewarding sustainable innovation; Value engineering	Development		
Audit; Good quality supplier; Supplier collaboration; Supplier requirements	Supplier		
ISO certification; Legislation is biggest driver	Norms and regulation		
Aftermarket division; Core value to save resource and energy; Determination to fix rather than replace; Different divisions for production and after market; External sustainability assessment; Saving energy in production	Sustainable operations		
99% of energy used in use phase; Customised casings to increase efficiency; Energy efficiency is driver; Energy efficiency is selling argument	Efficiency		
Products can be recycled; Reclaiming sand in foundry; Recycling for financial reason; Using recycled materials	Recycling		
Adjust to new requirements; Reuse pumps in different application	Retrofit		
Complex parts; Hybrid technology; Less spare parts; Licence files for spare parts; Short lead times over low cost	Additive manufacturing		
Monitoring to increase efficiency in operation; Monitoring to indicate malfunction in system	Monitoring equipment		

4.2.3.3 Plurality in PumpCo

In new equipment sales cost and technical feasibility is the driver for the customers. In repairs, it is technical feasibility and lead time is the driver. As part of their solution business PumpCo offers maintenance, spare part contracts, and retrofits of both PumpCo's and competitors' equipment, as customers are not so much price sensitive and more interested in short lead times. Having parts produced with hybrid manufacturing (repair solution, using scanning, additive manufacturing, and machining combined), for the repair of broken or production of new spare parts, the company gives products a second life. As the products in many cases operate for decades, and their requirements change over time, the company offers retrofits so just some parts and not the entire product need to be replaced.

According to PumpCo's Head of Engineering, the company aims to significantly reduce lead times and as well cut the material use and the requirement for spare parts, creating an opportunity for complementing logics.

“Currently it might take up to 15 weeks to supply a new part that would be cast using traditional methods, but we are setting ourselves a target of about 48 hours. So, lead times are key in the aftermarket business, especially if the customer has something that has failed and it is down to our critical service to have a spare part ... We are trying to get from measuring lead time in a matter of months to a matter of hours so that is one of the key targets and potentially in the future that could lead to customers having less stock retention because they will obviously know they can get parts much more quickly and don't need to keep spare parts. And if they do that it could lead to potentially less spare parts being required in the future and so in that way, you could say we will reduce consumption. Where you now only buy something when it breaks rather than buying a collection of things to cover all eventualities that may never happen.” [PU8].

For PumpCo, sustainability is currently not part of the corporate strategy and there is little commitment to ‘*make something that is green, but only things that make money*’. The goal is to produce a pump that is as safe as possible, not as environmentally friendly as possible – sustainability is a by-product and there is no margin to optimise the resource

efficiency more once the product does the job. According to the Head of Product Development and Core Technology, the business is extremely price driven and sensitive.

“We cannot make those perfect products because we won’t sell them. So we take as much as we can into consideration when we develop the products but there is a point where we draw a line and say ok, this is not now what is required from our customer and you cannot actively sell it at argument point – you cannot just say my product is green because we use materials coming from sustainable foundries, but by the way, they are 3 times more expensive”[PU7].

Energy efficiency is a selling argument for PumpCo, and the company strives to be among the most energy efficient in the market as only about 1% of the energy of the pumps’ lifetime is required in production and installation. The majority of energy is required in the use phase, so it is important that they run at their ideal designed point. These requirements may change over the years and the pump needs to be retrofitted to be at that ideal point, again to have the best efficiency. The company has products installed that run for decades and even over 100 years, which may lead to customers running products at the wrong level to the point where it is not efficient – a low flow or very high flow, so there you don’t have the maximum efficiency of the product. Customers need the pumps to run different volumes over time. The pump is only about 30% of the cost of the entire unit, so the internals get retrofitted to match the changing requirements and increase efficiency or can be used in a different application. Using its aftermarket capabilities, the company offers repairs and retrofits for both their own as well as competitors’ products.

The customers’ interest is to reduce the operating costs, which is usually electricity or fuel to run our pumps or their pumps and so that is why I think the main driver is in the cost – so if we can offer them a retrofit, which increases the efficiency by 5 or 10% let’s say and they spend \$1M per year on electricity, they will of course jump on it – so I would say the motivation in this case is always cost – if it is cheaper for them to run in terms of maintenance or efficiency, they will work with us and we are doing retrofit [PU7]

The end-customer value the efficiency as they help reduce the operational cost of the equipment. Sustainability is never of prime interest. This is particularly relevant as the market for PumpCo is increasingly shifting towards selling to EPC who have no interest in sustainability and TCO but only in low CAPEX. PumpCo has the capability to produce sustainable and efficient products, but many customers don't have an interest in that and want equipment as cheap as possible. PumpCo could make ever-so-efficient products, the engineering and production would just cost too much, so no customer affords them if they are much more expensive, and for only a little more efficiency. Further, for the engineered solutions for which it would be possible to design for the highest efficiency, the lead time in some cases is more important than thorough engineering to increase efficiency. The interviewees unanimously state that at the end of the day they need to sell products, and more sustainable ones are too expensive. And customers only pay a premium if it saves energy. PumpCo's Asian customers are increasingly concerned with low capital investment cost, rather than quality or repairability. Customers from the middle east are financially strong and just replace the entire pump. However, different customer groups request pumps that are repairable, according to the Value Engineering Process Manager.

“They require that the units be able to be re-buildable or reused over time because they have service cycles where they need to after so many hours pull the pump apart and replace seals and rings and bearings and so on, on a maintenance schedule. So again, being green isn't really the focus but ends up being the by-product of it – so it's more for reliability for safe operation and also reliable operation again because, remember too, one of our biggest customers is the oil and gas industry and when they have a down pump that needs repair, it is very expensive to shut the system down so then they are not producing – so I would say it is safety but it is also reliability”[PU6]

Using additive and hybrid manufacturing technologies is first and foremost chosen to cut lead times – not for resource efficiency. This indicates that traditional approach and sustainable PL are conflicting when the solution provider servitizes. Additive manufacturing is used for some parts, but in the most resource-intensive parts, the pump casings, the technology offers no benefits. Pumps casings need to be massively built so that the mass dampens the forces created by the rotation of the pump. Another benefit of additive manufacturing is that hollow forms can be produced to save weight, a benefit not

applicable for pumps, because thin, hollow construction because would risk that abrasion and corrosion would eat away the casing and make it leak. The technology would allow producing part decentral in smaller factories and not require a large foundry.

Producing precise parts using additive manufacturing is technically challenging to ensure the required quality and puts the company at risk of losing intellectual property. This suggests that the technology is probably only suitable for smaller, low-value plastic pump spare parts, that would normally be exchanged as a unit. The new technologies can reduce the number of spare parts needed but the customer needs the confidence for fast return, repair and supply of parts which requires time and resources to build it up as well as the real-world cases of broken equipment to test it.

The case of PumpCo shows how additive manufacturing to an industrial standard is much more complicated than commonly thought. Producing the powder for additive manufacturing is extremely energy intensive and much of the powder has to be remolten. So, from a thermal dynamic viewpoint, the casting and additive manufacturing are the same. According to the Head of Global Core Technologies Materials Pumps Equipment, producing the metal powder requires huge amounts of energy, as does the actual manufacturing process, which may lead to conflicting logics, in particular, if the energy is not generated from renewable resources.

“If we talk about carbon footprint of additive manufacturing, we have to melt the metal, we have to spray the metal into a big tank to produce the powder, there are sieving processes, sherardising processes and so on, which means the production of the powder already needs a lot of energy input. That much is clear, as everything starts with an ore metal and you need the same amount and then you put it in the chamber and you melt it again ... so from pure energy consumption on a thermal dynamic basis, I would say there is no big benefit in producing something via additive compared to casting.” [PU10]

The environmental consciousness varies both within the company and doesn't in all cases emphasise a sustainable PL, and as well differs in customer segments and geographies, in which some customers want more services which reduce the need for replacement and maintains efficiency. Although the main drivers are cost, lead-time, and technical feasibility, sustainability as a spillover is often a result of increased services, which can

indicate instances in which the traditional and sustainable PL are compatible when the solution provider servitizes.

Overall, sustainability in the development of solutions is relevant and internally recognised. For example, in the internal innovation awards where projects that were co-developed are recognised or in the value engineering which is, although aimed to reduce cost, ensures repairability and safe operation and reliability to guarantee the promised customer value. PumpCo co-develops solutions with their customers that lead to sustainable PL. For example, they developed equipment for predictive maintenance, with which through monitoring in the use phase it is possible to see differences in the operation of the equipment to see if there is a hole in the pipeline or elements in the pump are worn and need replacing, which maintains efficiency and prevents further damage.

Table 4-12 describes the PumpCo's source and cause of institutional demands of the production logic when shifting from a product to a service ML.

Table 4-12: Plurality caused by institutional pluralism in PumpCo

Occurrence of plurality	Source		Cause	
	Internal	External	Means	Goal
Conflicting logics				
Additive is chosen to cut lead-times – not for resource efficiency and requires the same amount of resources and energy as traditional manufacturing [PU8, PU10]	x			x
Cost, technical feasibility, and lead-time are the drivers, sustainability is never a factor, as the customers have no interest, even though PumpCo has the capability to produce sustainable and efficient products. [PU4, PU7, PU10]		x		x
Competing logics				
Additive manufacturing is not proven to save resources for PumpCo's applications and poses challenges to quality, IP protection, and customer relations. [PU8, PU9, PU10]	x		x	
The end-customer value the efficiency to reduce the operational cost, but EPC only want that much efficiency as they need to hold the capex low and not pay much more money for little more efficiency. [PU2, PU7]		x		x
Internal processes such as value engineering do not consider sustainability aspects for the mere lack of interest, and the incentive to save cost in the process. [PU6]	x			x
Compatible logics				
Customers environmental consciousness varies over different customer segments and geographies but added services reduces the need for replacement and maintains the efficiency. [PU7]		x	x	
Over 99% of the energy used during the equipment's lifetime is consumed in the use phase, running the equipment at their ideal designed point and change the equipment when the requirements change result in the best efficiency. [PU1, PU2]	x	x	x	
PumpCo has a division that delivers the services, such as supporting repair and spare parts, and upgrades pump equipment and give engineering assistance to service centres and field engineers to increase the lifetime and maintain efficiency of the equipment. [PU2, PU5]	x		x	
In the development of solutions, sustainability through longevity and efficiency is relevant and recognised. [PU5]	x			x
PumpCo has products installed that run for decades and offers retrofits, so the internals get retrofitted to match the changing requirements and maintain efficiency in the use phase. [PU2, PU4, PU7, PU9]	x		x	
PumpCo has strong capabilities in the aftermarket and retrofits and repairs as well competitors' products. [PU5, PU8]	x		x	
PumpCo has a reputation as one of the strongest players in the market with high quality, good reputation, reliable equipment, proactive and innovative development for which it extensively collaborates with their foundry suppliers to develop new products and ensure quality. [PU5, PU6, PU7]	x	x		x

Table 4-12: Plurality caused by institutional pluralism in PumpCo

Occurrence of plurality	Source	Cause
Additive manufacturing is great for spare parts when price customers are less cost sensitive and more interested in short lead times and eliminates the customers and PumpCo's requirement to have parts in stock and save on the physical resources and space for those spare parts. [PU8, PU9., PU10]	x	x
PumpCo uses additive manufacturing for the production of casting moulds to produce customised pumps with higher efficiency. [PU9, PU10]	x	x
PumpCo has co-developed equipment for predictive maintenance and monitoring with their customers to see differences in the operation of the equipment to see if the system runs ok and prevent further damage and maintain efficiency. [PU1, PU7]	x	x

4.3 Cross-case analysis

In the fourth and last step, the analysis compares and contrasts the findings from the within-case analysis as described in 3.5.2 to identify conditions under which the service ML and sustainable PL are conflicting, competing, and compatible. The number of occurrences of the source and cause identified in the three cases are depicted in Table 4-13.

Table 4-13: Source and cause in occurrences of institutional pluralism

Plurality	Case	Source		Cause	
		internal	external	means	goal
Conflicting	CableCo	-	3	1	2
	EVCo	2	3	2	4
	PumpCo	1	1	-	2
Competing	CableCo	2	1	-	2
	EVCo	2	2	1	3
	PumpCo	2	1	1	2
Compatible	CableCo	2	4	4	1
	EVCo	3	2	3	5
	PumpCo	7	5	8	1

4.3.1 Conflicting Market and Production Logics

Source of complexity

The sources for conflicting institutional logics for EVCo and PumpCo were both internal and external, and for CableCo, only external. All three companies share that the customers have no prime interest in sustainable solutions which indicates a traditional PL from the customer side. In the two cases of CableCo and EVCo, there is an external barrier to shifting towards a sustainable PL, which is the lack of a sustainable market. In the case of CableCo, polymers from renewable materials are not available in the required quality and durability, in the case of EVCo, it is the lack of a recycling market for the ABS cladding of their vehicles.

The analysis shows that the instances of an internal source of conflicting logic can be conscious and unconscious. For example, in the case of EVCo, it is a conscious decision that they do not treat or service the vehicles better in the 1st life, even though they get remanufactured for a 2nd life. Similarly, PumpCo chooses the manufacturing approach that is technologically the best and doesn't actively consider sustainability aspects in the

design and manufacturing. A less conscious result of traditional PL is that some parts for EVCo are not recyclable, which is the result of a design legacy and not considering re-manufacturability during design in the past.

Cause of complexity

The cause of sustainable PL conflicting with the service ML is predominantly in the ends for CableCo and EVCo, and exclusively in the ends for PumpCo. Conflicting logic at the means level indicates that it should be possible to resolve the complexity and alternatives would be possible. For example, through technological innovation, but the companies are externally hindered. An instance is CableCo who would use sustainable polymers but there is no market, or EVCo would make their vehicles easier accessible without the requirement of a motorcycle driving licence but cannot because of regulation.

The conflicting logics at the goals level indicates that a change towards sustainable PL is much harder to achieve. In the case of EVCo, conflicting logic at the goals level indicates that there is no market for recycled products, and they could not even be recycled to cover the cost, therefore the complexity is harder to resolve. The instances of conflicting logics at the goals level are embedded in the values of the respective manufacturers and their customers. In the case of the customers, it is that they have no interest in sustainable PL and if anything, just appreciate it as beneficial spillover effects of otherwise financially driven decisions. Customers overall value efficiency, price, and lead times over sustainability aspects. In the rarer instances where the manufacturers have no interest the sustainable PL it is that they value the more resource-intensive technology or lower cost over practising stewardship.

4.3.2 Competing Market and Production Logics

Source of complexity

The sources of complexity for sustainable PL competing with a service ML are equally balanced, both externally and internally, but slightly more often internally. The instances where the source is only internal occur when the company has to decide whether they want to choose a traditional or sustainable PL approach. This is predominantly a matter of choosing the more economic choice over a more sustainable alternative. The instances where the source lies externally is when customers are not willing to pay extra for a more

sustainable solution. In the case of EVCo, the customers decide to not use the vehicles as long as they could be used, in the case of PumpCo a conflict of interest exist between different actors, namely the EPC which are interested in low CAPEX, and the end customer who has an interest in low CAPEX.

In two instances of sustainable PL competing with a service ML, the source lay both internally and externally to the case company. In the example of EVCo, it is the case that for the provision of uptime, it depends on one hand how the company provides the uptime, on the other hand, the sustainability logics depends on the level of uptime the customer demands. Similarly, CableCo's solutions are designed to cost, and the company provides as much sustainability as is available for the budget, whereas the customers are not willing to pay more for sustainability. For PumpCo, the two logics are not necessarily competing. However, additive manufacturing in their case is not yet proven to be more sustainable than traditional methods, therefore the sustainable PL is contested.

Cause of complexity

The cause of complexity caused by a sustainable PL competing with a service ML are predominantly ideological. In all three cases there are multiple instances of trade-offs where practising stewardship in the RI comes at a cost, and the case company must decide at what price they want to practise stewardship in their operations. In the instance of CableCo, for example, the company must decide whether it is financially viable to collect cable reels and reuse packaging or if the volume of returned packaging and reels is not high enough to justify the cost of the logistics. For EVCo, the two logics are competing as the company must decide whether they want to recycle an EoL vehicle or remanufacture it, and by doing so have to allocate a financial value to the stewardship practice. EVCo presents an instance where the complexity is both at the means and the goals level, - that is the uptime of vehicles. On one hand the company can provide the uptime at a lower margin, or the customer could choose a lower uptime at the benefit of stewardship practice because, for example, more replacement vehicles would be required.

4.3.3 Compatible Market and Production Logics

Source of synergy

This section of the analysis identifies conditions under which the service ML and sustainable PL are compatible. The sources for synergies are balanced and occur both internally and externally to the case company.

The internal causes for compatible logics derive from the way how services are provided. CableCo, for example, reduces the use of resources because it designed reusable packaging. Further, the optimised design of their cable reels requires less transport volume and therefore resource use required in the logistic. Within their solution, EVCo can use remanufactured parts harvested from EoL vehicles or returned by their service partners in the maintenance of their flat-fee contracts. The internal source for changing towards a service ML is evidenced as those are internal strategic decisions. In the case of EVCo, for example, the company decided to remanufacture vehicles instead of disposing of them, and in the case of PumpCo, the company decided to engage in retrofit and aftersales for their own as well as competitors' equipment.

All three companies to some extent push the co-development with both customers and suppliers. This is predominantly driven by considerations of reducing cost. However, it does most often as well result in reducing the resources required. In the case of PumpCo, for example, the company closely works with their casting suppliers, whereas for example EVCo and CableCo work closely with their customers to reduce material in their solutions.

External sources of sustainable PL compatible with the change towards a service ML occur in some instances when customers require certain attributes and services in their solutions. In the instance of CableCo, the customers require for some products the use of reusable cable coils to integrate the coils into their operations. This reduces the waste at the customer end and the use of virgin material for CableCo. In the instance of EVCo, most customers do have an expectation towards a low TCO of their fleets. This is answered by EVCo providing vehicles designed for longevity and repairability. PumpCo's customers expect the equipment to be among the most efficient in the market in the use phase. Given that in most companies where PumpCo's equipment is used the

predominant source of energy is fossil-based, increasing the efficiency reduces the requirement of oil and gas for energy production.

As EVCo's vehicles are as well driven by electricity, increasing the efficiency also leads to reduced resource consumption. However, this is not as significant as most customers are in countries with a high proportion of renewable energy. A less significant reduction of resources in PumpCo's operation is the cut in lead times through additive manufacturing because, with shorter lead times for spare parts by the customers, both the customer and the manufacturer need as many parts in stock. External sources further stem as well from the market, driven by societal changes. In the case of CableCo, for example, the change in consumer behaviour of mobility that leads to increased sharing of vehicles requires higher quality products due to the intensified use, which is a core competence of the company.

Cause of synergy

The premise of sustainable PL is that it is made proactively through stewardship practice in the RI. In instances where servitization leads to environmentally beneficial spillover effects that reduce resources, then sustainable PL is only compatible with the service ML at the means, not in the goals level. Only in instances where the case company operates sustainably actively in their decision, the logics are compatible at the goals level.

The majority of compatible logics are at the means level. In CableCo and PumpCo this happens almost exclusively. In the case of EVCo, the cause lies in the end, and in some cases at the means and the goals level. For the two cases of CableCo and PumpCo, the cause for compatible logics is predominantly at the means level, which indicates that the sustainable PL coincides with the service ML. The solution components of CableCo, such as reusable cable reels, coils and packaging that lead to requiring less material are mainly driven by economic causes. Similarly, for PumpCo the driver to do retrofit comes from the need to increase the efficiency to save cost and the additive manufacturing is driven by cutting lead times, although it as a side effect requires as well less storage space and parts in stock.

In the case of EVCo however, the occurrences of compatible logics are most often both the means and the goals level. As part of their solutions, EVCo takes back the vehicles, which is at the goals level, and remanufactures them, which aligns with a sustainable PL.

Similarly, through their maintenance program, they can reuse parts that are repaired can be reused in the service. The company proactively practices stewardship in the RI for their solutions, therefore the compatible logics at the means and the goals level.

EVCo has instances where the logics are only compatible in the ends. That is where the customer either uses fewer resources through more efficient driving or proactively considers the full TCO in their operations. Compatible logics at the goals level for CableCo and PumpCo occur where only the market asks for higher longevity and quality in the products.

4.4 Multiple-case study findings

Extant research suggests that increasing servitization and offering CS as opposed to only selling products can increase the sustainability practice of a manufacturer. To explore how companies can practise stewardship in the RI, the foregoing analysis inquired under which conditions solutions businesses are sustainable. The analysis was guided by the conceptual framework developed in Section 2.6 and depicted in Figure 2-4. The findings presented in the following sections populate the components of the presented framework and describe conditions that are required for servitization to be sustainable.

First, the ideal types that describe the ML and PL for the three case companies (Sections 4.4.1 and 4.4.2). These ideal types act as a value system (Marrewijk, 2004) to describe the set of values, beliefs and corresponding behaviour found in the three cases (Table 4-18). Ideal types convey what is essential about a phenomenon, the lack or presence of stewardship practice in the RI in solution businesses, and how the different types react to pluralism.

Second, the pluralism caused by multiple present logics are described as conflicting, competing, and compatible logics Section (4.4.3). The pluralism results in complexity and synergy and is differentiated by the source (internal or external) and the cause (means or goals level) which helps conclude on how to resolve the complexity.

4.4.1 Market Logics

Market logics are the ideal types that describe the locus of value creation in solution businesses (Grönroos and Voima, 2013). The 2nd order categories for the ML that derived

in the analysis in Section 4.2 were unified and resulted six categories for the product ML as portrayed in Table 4-14 and in seven service ML as portrayed in Table 4-15. In this process of unifying, 2nd order categories from the three cases which had the same or a similar meaning were clustered. The full account of the coding structure is attached in Appendix B or the product and market logics.

Value for the customer in a product ML is embedded in the product and realised through sales of the product (Green et al., 2017). This logic assumes that value is objective and produced internally within an organisation and embedded in offerings during the production process. The logic emphasises operand resources and regards services as an extension of the firm's manufacturing capabilities. The data suggest that the product ML is characterised by low-value products with predominantly passive components.

The manufacturers have an internal focus on the development and production of products in which they oftentimes must follow confining industry standards that dictate the design and required manufacturing processes. The lack of electronics in the manufactured devices and components often leads to a lack of customer feedback which the manufacturers only receive in case of malfunction or breakage. The product ML, however, is not only the result of the manufacturers' doing but as well determined by the customers' lack of interest in servitized offerings. The customers in many cases do not wish to have advanced services which would require increased supplier integration and, in some cases, have no interest in the total cost of ownership, but rather require lower investment costs.

In a service ML, the value is subjectively co-created collaboratively with the customer and realised when the customer uses the firm's offering (Edvardsson et al., 2011). The emphasis of the logic in the RI lies on the operand resources with a focus on outcomes. The practices that indicate a service ML in the manufacturer's solutions are evident in all lifecycle stages of the solution. At the EoL, the manufacturers use their established engineering and manufacturing capabilities to co-develop solutions together with their customers and suppliers.

Table 4-14: Unified 2nd order category of product market logic

2 nd order categories	Unified 2 nd order category	Referenced in
No customer feedback	No customer feedback	CableCo
No service because low value; Passive components	Low value, passive components	CableCo, PumpCo
Limited-service component; No interest in service; No wish for supplier integration; Separate service	No interest for advanced service and supplier integration	EVCO, PumpCo
No special servicing because of takeback; Product focus in value engineering	Internal product focus	EVCo, PumpCo
Confining industry standards; Standards define products	Confining industry standards	CableCo, PumpCo
No interest in TCO by EPC; No consideration of TCO	No interest in TCO	EVCo, PumpCo

In this process of customisation, the solution provider together with their customers develops and agrees upon quantifiable KPIs which are a cornerstone of the service contracts and include indicators such as response time and agreed equipment uptime. The solution provider offers different services during the use phase, such as regular servicing, repairs, spare parts, and replacement equipment to ensure the agreed uptime. At the end of the first technical lifetime, the solution providers offer an EoL solution such as remanufacturing of equipment, professional disposal, or retrofitting to changing customer requirements.

Table 4-15: Unified 2nd order category of service market logic

2 nd order categories	Unified 2 nd order category	Referenced in
Added service, Remote monitoring, 3 rd -party equipment. Service operations	Service in the use phase	CableCo, EVCo, PumpCo
Capabilities; Remanufacturing; Capabilities; Spare parts; Reputation	Engineering and manufacturing capabilities	CableCo, EVCo, PumpCo
Sell 2nd life vehicles; Retrofit; Take back vehicles; Battery lifecycle	EoL solution	EVCo, PumpCo
Closeness to customer; Fleet management; Co-development; Solution development; Customer solutions	Co-development with customers and suppliers	CableCo, EVCo, PumpCo
Customer Value; Efficiency; Change in customers business models	Quantifiable KPI	CableCo, EVCo, PumpCo
Customisation; Customer segments	Customisation	EVCo, PumpCo
Service contracts; Uptime	Service contracts	EVCo, PumpCo

4.4.2 Production Logics

Production logics are the ideal types that describe the observable stewardship practice in the RI of solution businesses (Storbacka et al., 2016). The 2nd order categories for the PL that derived in the analysis in Section 4.2 were unified and resulted six categories for the traditional PL as portrayed in Table 4-16 and in twelve sustainable PL service ML as portrayed in Table 4-17. The full account of the coding structure for the service and production logics is attached in Appendix B.

Traditional PL are characterised by RI systems which convert natural resources into waste via production, deplete natural capital and virgin resources, and reduce natural capital through waste and pollution (Murray et al., 2017). The logic assumes an unlimited number of resources and a planet with a limitless capacity to assimilate waste created by production and consumption. The traditional PL in the manufacturers' practices and beliefs have both cultural and technical backgrounds. In some cases, the internal culture for sustainable production is not established and the main driver for decision-making is financial profit.

The cost for more sustainable solutions would in most cases be higher and the customers are not willing to pay a price premium for more sustainable solutions. Similarly, for some of the materials and products, there is no sustainable EoL market and products get incinerated. The manufacturers further face technical limitations to producing more sustainably because materials from renewable sources do not meet the technical requirements. External factors that result in a more traditional PL are regulations and standards, which manufacturers must comply with and therefore have little room for improvement in the design to become more sustainable.

Sustainable PL are characterised by practising stewardship in the RI process. Practising stewardship can be identified when companies follow CE principles in the decision-making in the chain of reasoning with the aim to stepwise transform from a linear to a CE (Widmer et al., 2018). The logic assumes that through innovation, economic growth can be decoupled from the consumption of finite resources. The sustainable PL is evidenced on one hand through cultural indicators on the one hand, and the stewardship practice on the other hand.

Table 4-16: Unified 2nd order category of traditional production logic

2 nd order categories	Unified 2 nd order category	Referenced in
Customer requirement; No interest in sustainability by customer; Cost is driver; Early replacement of vehicle	Driven by cost not sustainability	CableCo, EVCo, PumpCo
Maintenance; Cost for remanufacturing	Too high internal cost	EVCo
Internal culture; Internal sustainability; Value engineering; EoL Strategy	Internal culture	CableCo, PumpCo
Technical; Limits to additive manufacturing; Properties; Safety requirements	Technical limitations to sustainability	CableCo, EVCo, PumpCo
Recycling; Recycle	Recycling	EVCo, PumpCo
Regulation; Regulation and standards	Regulation and standards	EVCo, PumpCo

The manufacturers' internal sustainable culture leads to the acceptance of more sustainable ideas and acknowledges the relevance of environmental sustainability. For the manufacturer, it is important to have a sustainable image and develop sustainable technology and as well have high requirements towards their suppliers and make sure they comply with the set codes of conduct. Sustainability informs the development, using CE principles, to practise environmental sustainability.

Table 4-17: Unified 2nd order category of sustainable production logic

2 nd order categories	Unified 2 nd order category	Referenced in
Customer requirements; Customer interest in sustainability	Customers requirement for sustainable practice	CableCo, PumpCo
External pressure; Norms and regulation	External pressure to adapt sustainable practice	CableCo, PumpCo
Internal culture; Sustainable culture	Internal sustainable culture	CableCo, EVCo
Development	Sustainability informed development	EVCo, PumpCo
Reputation; Image	Sustainable image	CableCo, EVCo
Sustainable technology; Market	Sustainable technology	CableCo, PumpCo
Supplier	Supplier requirement	PumpCo
Non-Toxic resources	Pure and nontoxic materials	CableCo
Resource efficiency; Sustainability; Additive manufacturing	Resource efficiency	CableCo, EVCo, PumpCo
Use-phase; Efficiency; Monitoring equipment; Sustainable operations	Efficiency in use phase	EVCo, PumpCo
Longevity; Reuse parts; Take back; Remanufacturing; 2 nd life; Retrofit	Keep value high for as long as possible	CableCo, EVCo, PumpCo
Recycling; Battery; Battery after 1 st life	Recycling	EVCo, PumpCo

For the manufacturers in the presented study the stewardship practice considers aspects of resource efficiency in all stages of the lifecycle of the solutions. Equipment is produced from pure and nontoxic materials which allows the recovery of materials during the production process and at the EoL. If the energy consumption of the solution in the use phase is significant, the manufacturers aim to increase the efficiency as much as possible. Through maintenance and different recovery strategies, such as remanufacturing and retrofitting, the manufacturers aim to keep the value of materials and products high for as long as possible and only recycle as a last resort. The solution providers practice stewardship out of their own motivation, also because customers increasingly require sustainable practice and external pressure to adopt sustainable practice arise from the labour market, financial institutions, and society at large expects it from the manufacturers.

Derived from the notion that the nature of institutional demands and pressure on organisations can be either at the ideological goals or the functional means level as described in Section 2.4.5 (Pache and Santos, 2013), the unified 2nd order categories are further differentiated. Logics that manifest at the means level are the material practices of the logics, whereas logics that manifest at the goals level are the values and beliefs of the logics. This differentiation, as presented in Table 4-18, resulted in a detailed description of the four logics concerned in this research.

This results in four practices (no customer feedback, low-value passive components, internal product focus, and confining industry standards) as well as two values and beliefs for the product ML (no interest in TCO, no interest for advanced service and supplier integration) and three practices (service in the use phase, engineering and manufacturing capabilities, quantifiable KPI) as well as four values and beliefs (service contracts, customisation, co-development with customers and suppliers, EoL solution) for the service ML.

Two practices (technical limitations to sustainability, recycling) and four values and beliefs were identified for the traditional PL (too high internal cost, driven by cost not sustainability, internal culture, regulation and standards) and six practices (sustainable technology, pure and nontoxic materials, resource efficiency, efficiency in use phase,

keep value high for as long as possible, recycling) and six values and beliefs (customers requirement for sustainable practice, external pressure to adapt sustainable practice, internal sustainable culture, sustainability informed development, sustainable image, supplier requirement) for the sustainable PL.

Table 4-18: Ideal types of logics

Logic	Product market logic Value in the product (embedded)	Service market logic Value-in-use (outcome)	Traditional production logic	Sustainable production logic
<i>Definition</i>	ViU is delivered by the firm and its value proposition has embedded value (Green et al., 2017).	ViU is co-created, with the customer an active participant and contributor to value creation during the use of the offering (Edvardsson et al., 2011).	Continuous economic growth predicated upon continuous intensive energy and resource consumption for own profit and externalising the true costs (Murray et al., 2017).	Growth is independent of finite stocks of resources, eliminates waste, reduces the flow of material through the economic system and virgin-material consumption based on circular economy principles to preserve resources (Widmer et al., 2018).
<i>Practices</i>	<ul style="list-style-type: none"> • No customer feedback • Low-value, passive components • Internal product focus • Confining industry standards 	<ul style="list-style-type: none"> • Service in the use phase • Engineering and manufacturing capabilities • Quantifiable KPI 	<ul style="list-style-type: none"> • Technical limitations to sustainability • Recycling 	<ul style="list-style-type: none"> • Sustainable technology • Pure and nontoxic materials • Resource efficiency • Efficiency in use phase • Keep value high for as long as possible • Recycling
<i>Values and beliefs</i>	<ul style="list-style-type: none"> • No interest in TCO • No interest for advanced service and supplier integration 	<ul style="list-style-type: none"> • Service contracts • Customisation • Co-development with customers and suppliers • EoL solution 	<ul style="list-style-type: none"> • Too high internal cost • Driven by cost, not sustainability • Internal culture Regulation and standards 	<ul style="list-style-type: none"> • Customers requirement for sustainable practice • External pressure to adapt sustainable practice • Internal sustainable culture • Sustainability informed development • Sustainable image • Supplier requirement

4.4.3 Main Occurrences of Plurality

The data from the three case studies demonstrates that the source of the logic can be internal and external to the organisation. For the actors in the solution business, such as the manufacturer and the customer, the cause of the institutional demands can manifest at the means level of how resources are integrated and at the goals level of the actor, which are the beliefs of the actors' value system. The findings listed in Table 4-19 indicate that the source and cause of the pluralism of logics has implications for the solutions business. The main occurrences of pluralism are described hereafter.

Table 4-19: Occurrences of plurality

		Source of demands		Cause of demands	
		Internal	External	Means	Goal
No internal interest and consideration of sustainability	Conflicting	x		x	x
No customer interest in advanced services and sustainability	Conflicting		x		x
Restricting laws and regulation Flexibility although does exist	Conflicting		x	x	
Lack of technologies and markets	Conflicting		x	x	x
Internal must make trade-off financial and uptime	Competing	x			x
Sustainable solution business	Compatible	x		x	x
Customers demanding resource efficiency	Compatible		x	x	x

No internal interest and consideration of sustainability

Conflicting logics with internal representation that originate from the means of how the resources are integrated occurred in all cases. The conflict occurred in the choice of the technical characteristics of the solution components. In the case of CableCo the company has not thoroughly investigated the possibility of renewable polymers. Sustainable production was as well not considered by PumpCo when planning their additive manufacturing. The choice was made irrespective of a sustainability aspect and therefore does not conflict at the goals, but only at a means level. EVCo has some components in their vehicles that cannot be recovered at their highest value, because of a legacy design that was made years ago. The lack of interest in stewardship practice sources from within

the manufacturer. Not considering sustainability in the RI can be caused by the ideology and beliefs through a conscious decision to not practise stewardship, or a negative spillover effect of the servitization efforts and therefore are to be assigned at the means level.

No customer interest in advanced services and sustainability

In the investigated cases, all manufacturers had the external conflict in common that their customers do not want the kind of high level of servitization such as outcome-based contracts that are widely discussed in the literature as the one with the highest stewardship potential. In all cases, the data suggests that no customer would be willing to pay a price premium for a more sustainable solution. In the case of EVCo, the customers could use the vehicles longer, but they retire them, usually before their EoL. Therefore, even though the manufacturer would be able to provide a more sustainable solution, they cannot realise it. Conflicting logics can as well occur between two downstream actors as exemplified by the case of PumpCo, due to conflicting interests. The end customer has an interest in both low investment cost and low operating cost, whereas the EPC contractors who procure the equipment only have an interest in low investment cost.

Restricting laws and regulation although flexibility does exist

The cases revealed instances in which stewardship cannot be practised because of existing regulations and norms. These external sources would have the capability to increase the stewardship practice, such as changing the laws regarding re-manufactured vehicles in the case of EVCo or the industry norms in the case of PumpCo which are predominantly developed by the customers. The cause of these conflicting logics is at the means level, as other ways of integrating resources would be possible, but the external actors have not prioritised these issues.

Lack of technologies and markets

External conflicts that hinder the manufacturers from practising stewardship originate not only from the customers and legislation but as well the production partners of the manufacturers, even if the manufacturers would want to operate more sustainably. The

lack of technical or market possibilities is, for example, shown in CableCo, who decided to choose established polymers over the risk of novel materials because they are not technologically sound, or PumpCo, who despite using modern additive manufacturing methods, consumes enormous amounts of energy in their production. The lack of novel sustainability suggests that the cause is at the means level as alternatives would be considered if available. A different case, however, is EVCo. The company has components that are not currently recycled although they would be pure as materials, which indicates a conflict originating from outside the organisation in the recycling industry. Recycling would be possible but is not as profitable as producing from virgin materials, which locates the cause of the conflict at the goals level.

Internal must make trade-off financial and uptime

The main occurrence of a sustainable PL competing with a service ML when servitizing can be interpreted as trade-offs between achieving environmental sustainability, profitability, and sufficient safety. In all three cases, it could be observed that there was a clear hierarchy of economic and environmental values. For all cases, more sustainable solutions would be possible but are mostly not realised due to financial limitations. This prioritising indicates that the nature of the institutional complexity is at the goals level and companies must decide to either prioritise the service ML or the sustainable PL. All cases prioritised profit over environmental sustainability.

User safety was in the cases of EVCo and PumpCo mentioned to be above economic profit. For CableCo and EVCo it is the case that only under certain circumstances and quantities it is economically viable to accommodate a sustainable PL, otherwise, it is not profitable. For the smaller company EVCo, it was the case that selling remanufactured products was not as profitable as selling new products, so to ensure the economic performance of the company, selling new products with higher profit margins is required to sustain remanufacturing operations and stewardship practice. For CableCo it is the case that they must decide if the cost is worth developing a collection network and what the large enough quantities are. PumpCo and EVCo further have to decide on how they want to provide the uptime of their equipment and how resource intensive the uptime should

be. For example, having spare parts and replacement vehicles. The instances in which competing logics were found suggest that when logics are competing, they are internal and competing ideologically rather than functional. Competing at the goals level indicates that the organisation took a deliberate choice of one over the other.

Sustainable solution business

Sustainable PL compatible with the service ML occur in all three cases. However, they differ in the cause of the synergy. In all three cases, there are instances in which a component of the solution leads to the reduction of virgin materials. In the instances of CableCo and EVCo that is through reusing parts and components. In the instance of PumpCo it is through eliminating the requirement of stocking spare parts and retrofitting with the help of additive manufacturing. The three cases practice reusing, remanufacturing, and novel additive manufacturing as the means to achieve their servitization goals, equally as their sustainable production goals.

In the cases of PumpCo and CableCo, the environmental beneficial results of changing towards a service ML are not intentioned and spillover effects of efforts to increase financial goals. Because the environmental benefits are spillover effects due to increased resource efficiency, they are at the means and not the goals level. In the case of EVCo, the company proactively practises stewardship through their re-manufacturing and accepts lower margins compared to the sale of new vehicles. Because of this proactive stewardship practice, the logics are not only compatible at the means but as well at the goals level. Stewardship practice is further supported when requested by the customers.

Customers demanding resource efficiency

For the customers, a similar circumstance applies in that it can be both at the means and at the goals level. In the case of CableCo, the customers require the reuse of packing and integration thereof into their production line. However, the demand is caused by the motivation for cost reduction and not to achieve environmental sustainability, and therefore only at the means level. The consideration of TCO by some of EVCo's customers is similar. However, these as well are mostly driven by economic motivation.

Some of EVCo's customers do, for example, monitor their personnel's driving behaviour with the aim to reduce to energy and resources driven by the sustainability goals.

4.5 Conditions for Sustainable Customer Solutions: Answering RQ1

This multiple-case study presented was conducted to answer the first research question developed in Section 1.3 asking: *When is resource integration in customer solutions sustainable?* To answer this question, the study used ideal types (Marrewijk, 2004) to identify the practices (Storbacka et al., 2016), values, and beliefs of the PL and ML and analysed how the sustainable PL of three manufacturers is conflicting, competing, and compatible with their service ML (Greenwood et al., 2011). These ideal types of ML and PL Table 4-18 build the foundation to answer this sub-research question.

The findings of this research have shown that servitization requires changes in the RI practices which may be compatible, competing, or conflicting with the RI practices required to align with the practices for sustainable PL. The study identified four conflicting, one competing, and two compatible occurrences of plurality. The identified occurrences of pluralism have their source both internal and external to the manufacturer and are caused both at the means and the goals level.

Conflicting logics pose barriers to becoming more sustainable and are predominantly external to the manufacturer. These barriers to becoming more sustainable are both technical as well as cultural. The one internal occurrence is the lack of internal interest in sustainability, which can be seen as a cultural barrier at the goals level with the effect that individuals don't practice stewardship in the RI. This is at the means level. The study found further that the same cause, no interest in sustainability, can be found as well within the customer. Other external occurrences of conflicting logics are regulations and norms that hinder the adoption of sustainable PL, which are caused by the means as flexibility exists to change such. As with the restricting regulations, the lack of technology and markets for recovered material is at the means level. These latter two barriers, although predominantly at the means level, manifest as well at the goals level. If external

companies would not only be driven by economic considerations, but would be more sustainability driven, sustainable PL could also be possible and technological barriers could be overcome.

The major occurrence of sustainable PL competing with the shift towards a service ML is an internal financial trade-off the manufacturers must make as to how much sustainability is economically viable. The manufacturers servitize primarily so that their customers can achieve their economic goals. The customers' priority for achieving economic goals limits the manufacturers' ability to strive for sustainability and they can only increase their stewardship practice to a certain degree, where the costs are not increasing. These competing conditions must be navigated by the manufacturers and a conscious decision must be made whether stewardship can be practised or not.

The study identified one internal and one external occurrence in which servitization lead to increasing stewardship practice. The solution business is sustainable when the RI practice for changing the ML is compatible with the stewardship practice in the RI required for a sustainable PL. RI practices which are compatible with sustainable PL can, however, be intentional and therefore at the goals level, or unintentional spillover effects and at a means level. A truly sustainable solution business is when stewardship is intentionally practised at the RI level. The sustainable PL is at the goals level and proactively pursued. The sustainable practice is further externally accelerated if customers demand resource efficiency, which can be both driven by the goal to be more sustainable or the result of wanting to increase efficiency for cost-saving purposes.

Concluding this study, the findings suggest that manufacturers' stewardship practice can increase through servitization, both intentionally and unintentionally. The manufacturers must make conscious decisions on whether they proactively want to practise stewardship because they must make a trade-off as to what degree stewardship practice is financially viable. Barriers to practise stewardship exist internally and externally and can be both technical and cultural. Manufacturers who servitize are not categorically sustainable and pure types do not exist. All companies blend multiple PL and ML at the same time which

must be navigated collaboratively between the solution provider and the customers to create conditions in which solution businesses are sustainable.

5 SINGLE-CASE STUDY: CREATING VALUE IN SUSTAINABLE CUSTOMER SOLUTIONS: THE CASE OF EVCO

This single-case study aims to explore how value in sustainable solution business is created. To understand the mechanisms of value creation, the study relies on the components service market logic (ML) and sustainable production logic (PL) developed in the conceptual framework in Section 2.6. In particular, the study is concerned with instances in which the two logics are compatible, and resource integration (RI) leads to the achievement of multiple goals.

5.1 Data Analysis Procedure in the Single-Case Study

The selection of the case study company is the result of the preceding multiple-case study in Chapter 4 which used a maximum variability sampling strategy (Patton, 2015) as a sampling procedure. The maximum variation sampling allowed to identify one of the three companies as a ‘single significant case’ (Patton, 2015). This single-case provides a rich and deep understanding of the subject with its distinct, major dimensions and stand-out importance in the context studied and offers insights that stand alone, without attempting to generalise. The case that forms the unit of analysis in this study is the service-ecosystem around a focal manufacturing firm (Patton, 2015). The case of EVCo was selected to explore their service ecosystem further because it is the company that practices stewardship the most proactively and showed the most compatible service ML and the sustainable PL.

The study took an ego-network approach (Provan et al., 2007) around EVCo that identified a network of companies that are directly in contact with the focal firm. The data collection started with one information-rich interview with the CEO who referred to further employees within the company and established contact to their customers. Through snowballing (Patton, 2015) further contacts were identified by asking interviewees for people who can provide different and/or confirming perspectives.

Figure 5-1 depicts the network around the focal firm EVCo. The data for this study consists of collected primary data from EVCo, NGOs, and independent research organisations and major business customers. The major business customers in the study are similar in size and organisation and operate in a similar environment, as they are all wholly state-owned, have the universal service requirement on letter mail, and have residual partial monopolies in the letter business. They are called 1stMail, 2ndMail and 3rdMail, according to the point in time when they became a customer to EVCo. 1stMail is the largest and longest-standing customer and based in Europe, 2ndMail in Europe and 3rdMail in Asia-Pacific have started building their fleets in 2016. Through the interviews, the additional actors suppliers, service partners, waste management companies, and the post companies' customers are identified as further actors. No primary data was collected with those additional actors.

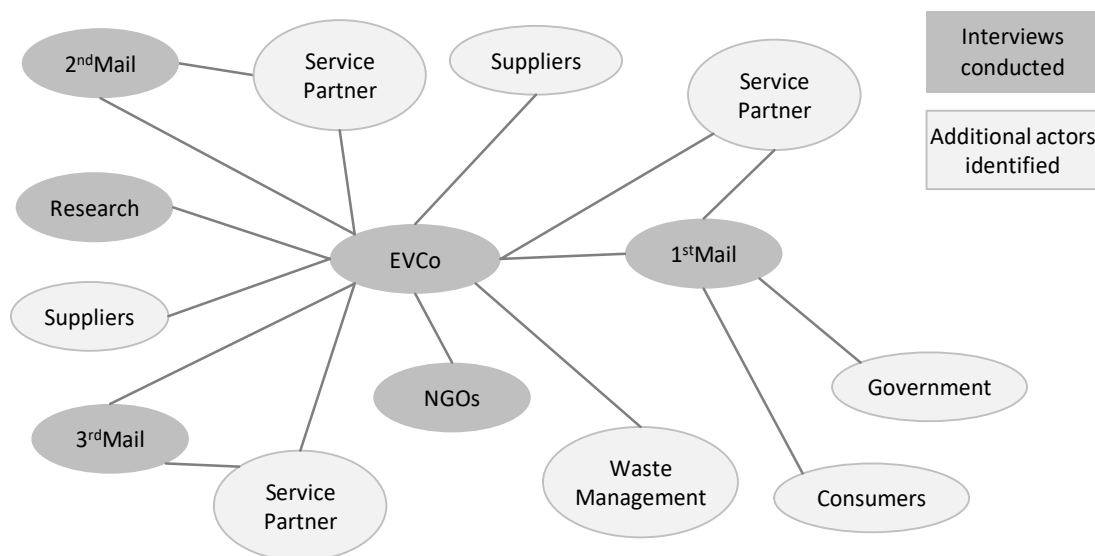


Figure 5-1: Case service-ecosystem

The main source of data for the case study is 23 of the 43 interviews conducted. The detailed accounts of the interviewees for the companies can be found in Table 3-2 (EVCo EV1-EV10; Customers C1-C9, Expert CE1-CE4). The questionnaires for the 13 interviews with the customers and the experts in CE were developed specifically for the single case study, whereas the interviews with EVCo are the same datasets as the ones for the multiple-case study in Chapter 4. An exemplary questionnaire with one of EVCo's

customers is attached in Appendix A.4. The interviews were triangulated with secondary data such as policy documents and annual reports to increase the trustworthiness and validity of the study. As identified earlier in this research, as part of the data collection, all interviews were transcribed in vivo and other data such as observations, supplementing documents, and field notes were digitalised and imported into the data analysis software NVivo 12 Plus by QSR International.

Given the large amount of empirical data, the analysis proceeded in 4 steps as described in Table 5-1. In steps 1-3 a thematic analysis was conducted as explained in Section 3.5.1 to derive at 1st order codes, 2nd order categories, and 3rd order dimensions which were identified in the literature and conceptualised in the research framework to identify instances that mentioned stewardship practice, value propositions, and customer value. In step 4, the themes were analysed by developing means-end chains as explained Section 3.5.2 to identify instances where a linkage of stewardship practice, value propositions, and customer value existed.

Table 5-1: Steps of single-case analysis

Steps	Description	Activity
Step 1	Identifying stewardship practice	Coding interviews at instances where interviewees mentioned stewardship practice
Step 2	Identifying value propositions	Coding interviews at instances where interviewees mentioned value propositions
Step 3	Identifying sustainable customer value	Coding interviews at instances where interviewees mentioned customer value
Step 4	Conducting means-end analysis	Identifying sections in the interviews in which a linkage of stewardship practice, value propositions, and customer value existed using means-end chain analysis

5.2 Thematic Analysis

The thematic analysis was informed by the literature on customer value introduced in Section 2.1.1. This literature postulates a hierarchy of three levels between attributes of products and services, benefits that are consequences that result through the use of attributes, and values of customers (Mentzer et al., 1997). On the most tangible level are the attributes, which in this research are the resources integrated by the solution provider.

On the second, more abstract level, are the benefits that the integration of the resources promises. These are the components of the value proposition that are used to communicate how the integration of the resource will serve the customers. On the most abstract level, the ViU describes how the value, that customers seek to achieve their goals, is created. The data revealed twelve integrated resources, fourteen value proposition components, and eight ViU constructs as listed in Table 5-2.

Table 5-2: Identified solution components

Integrated resources		Value proposition component		Value-in-use	
Electric vehicle	9	Extended resource lifetime*	9	Lower cost	1
					2
Technical properties	9	Best tool for doing the job	7	Availability	8
Expert knowledge	8	Adaptable to market changes	6	Grow business	7
Solution Contracting	8	Improved vehicles	6	Corporate citizenship	7
Configurability of vehicles*	7	Durability of vehicle	5	Reduced resource consumption production	7
Fleet management	6	Outsourcing responsibility*	5	Reduced resource leakage and waste at EoL	5
Continuous improvement process	5	Reliability of vehicle*	5	Reduced resource consumption in use	4
Relationships	5	Cheaper vehicles and spares*	4	Safer vehicle use	4
Battery recycling*	4	Emission-free electric drive	4		
Culture	4	Higher productivity	4		
Compliance	4	Communication tool	3		
2 nd life program*	3	Driver feedback	3		
		Transparency and predictability of operating cost*	3		
		Low entry barriers	2		

* Indicates resources and Value proposition components that were not relevant in the means-end chain analysis

5.2.1 Integrated Resources

5.2.1.1 Operant Resources

Six main operant resources manifest within EVCo's practice (compliance, continuous improvement process, culture, expert knowledge, relationships, solution contracting) that enable EVCo to develop and offer sustainable value propositions. These invisible, intangible, dynamic, and infinite operant resources are the micro-foundations (Storbacka et al., 2016) of stewardship practice that act on the tangible, static, and finite products and components of the solution. The RI literature suggests that the intangible operant resource

work on the operand tangible resources (Madhavaram and Hunt, 2008). A detailed account of all resources and how operant resources work on the operand ones is described in Section 5.3. The coding of those resource is presented in Table 5-3.

Compliance - EVCo complies with local and international standards such as ISO9001 and ISO14001, which dictates certain processes for the company but as well sets benchmarks for what is expected from service partners and suppliers.

Continuous improvement process -EVCo's has a process in place for the continuous improvement of products and services and to discuss acute problems in their solutions as well as general technical issues, which are then continuously solved.

Culture - EVCo has a strong culture supporting sustainability and innovation, much of which represents the founder's personality. They are always on the search for answers and better solutions, shape the processes in the company and supports both efficient and sustainable operations.

Expert knowledge - EVCo possesses expert knowledge and has an in-depth understanding of the customers' needs and use of the vehicles by the end-user combined with both internal and external technical knowledge of the products.

Relationships - EVCo maintains strong relations with customers, service partners, suppliers, and other actors in the service-ecosystem that are characterised by an exchange of information, trust, and mutual commitments.

Solution Contracting - EVCo offers in most cases solutions which are equipment sales with an added service package or flat fee over an agreed period to ensure long-term service and the consideration of the entire life cycle.

5.2.1.2 Operand Resources

Six main operand resources manifest within EVCo's practice (2nd life program, battery recycling, configurability of vehicles, electric vehicle, fleet management, technical properties) which are the physical, tangible, static, and finite resources that lay the foundation for EVCo's sustainable value proposition. The coding of those resource is presented in Table 5-4.

2nd life program - EVCo seeks that all customers, including private ones, return their vehicles so that they are not unprofessionally disposed of and can, where possible, be remanufactured and used again in a second life.

Battery recycling - EVCo has developed a battery recycling process for the EoL of the batteries to mechanically recover materials without heat or chemicals.

Configurability of vehicles - The solutions are based on standard products which are customised to suit the customers with specific requirements depending on their need.

Electric vehicle – All vehicles are exclusively electrical, with battery-powered drivetrains that, opposed to a combustion engine, represents both technical innovation and a social change from fossil fuels to renewable energy.

Fleet management - EVCo's has developed a digital customisable platform which allows monitoring the vehicles' use via remote sensing and planning the fleet's operations.

Technical properties - The specification of the vehicles that describe their technical properties and make them comparable to competitors' products in tendering processes are unique to EVCo.

Table 5-3: Operant resources in customer solution

1 st Order Codes Statements that mention....	2 nd Order Categories	3 rd Order Dimension	Illustrative Quote
Audit suppliers; ISO certified; WTO rules/tender; Customer code of conduct; EU Directive for minimum longevity; ECOVADIS	Production	Compliance	“Customers request that we are sustainable, and we try to push that to the suppliers. We source globally as some of the parts we need you only get from Asia, especially the batteries, so there it is important to us that we visit and audit those suppliers to see their production, and if we see that someone is employing children or so, that is a no go” [EV4].
Vehicle category; Regulation of use; Standards for partners	Use phase		
Hazardous materials; Waste disposal	End of life		
Model maintenance process; Technical improvement; Monitor frequency of part failure	Product improvement	Continuous improvement process	“The official process for improvement is a bi-weekly meeting which is held for each product, led by the product owning engineer. In this meeting representatives from maintenance, production, procurement, and engineering discuss what components regularly break down, what is not efficient, and tasks are allocated to investigate these issues” [EV8].
KAIZEN; Shop floor meetings	Production improvement”		
rewarding sustainability thinking; Ideology; ownership structure; Do good and talk about it; Sustainability appeals	Company culture	Culture	“Continuous improvement is necessary; what matters is that there is no standing still. It is either progress or regress. That means that if I don't focus on the progress, I fall into regress. That means we are not doing things as we always did, but improvement takes place everywhere and all the time...If products are exceptionally good and last, time can be invested in developing new products, rather than spending it with troubleshooting” [EV3].
Representing country; Customers culture fit	Customer culture		
pragmatic problem solver; Close internal collaboration; Don't see problem but offer solution	Work attitude		
Develop wide scope of products; Multiply through service partners; Scaling across customers; outsourcing	Scaling knowledge	Expert knowledge	“One way to ensure that the products are designed for durability, repairs, and service is that the engineer who designs the product has to assemble it himself and as well write the instruction manual how this is done. In this way, the engineers get the first-hand experience how the handling is and strengthens the relationship between the engineering, production, and maintenance team” [EV8].
Good reputation as problem solver; competence in all life phases; understand end user; Predicting maintenance	Customer focus		
Internal ideas; Internal engineering capabilities; assessing sustainability of projects; High investment in R&D;	Engineering capabilities		

Table 5-3: Operant resources in customer solution

1 st Order Codes Statements that mention....	2 nd Order Categories	3 rd Order Dimension	Illustrative Quote
Developing on own cost; Safety relevant features			
build up local service networks; Multiply through network; customer reference	Partner network	Relationships	<i>“Our external partners have access to our ERP system, so if they do service work for our customers, they log it directly to our ERP with a cost estimate, and we can approve it, and then the service partner conducts the work ... We want that the postman via our portal can, for example, log that the vehicle makes strange noises. And then we can out of that generate a service order to a service partner. That would be then consistent from the first request to the finished job” [EV4].</i>
Co-develop solutions; customer to end consumer; accompany customer; open to help customers	Customer relation		
involve suppliers; Global sourcing	Suppliers		
last mile delivery; increasing uptime; low response time	Solution benefits	Solution Contracting	<i>“Some customers have maintenance contracts which include an agreed lifetime and time until they are back on the road if they break down. An example, a vehicle that is today reported broken by 1stMail until 1 pm has to be repaired the next day, and ready for service the day after at 7 am” [EV2].</i>
Pricing; Penalty; leasing; pay-per-use; Flat fee	Contracting		
customer data; TCO; KPI Performance	Measuring performance		
ERP integration; life cycle; take back scheme; Service network	Lifecycle solution		

Table 5-4: Operand resources in customer solution

1 st Order Codes Statements that mention....	2 nd Order Categories	3 rd Order Dimension	Illustrative Quote
Dismantle process; Reuse parts; New plastic cladding; Harvest parts; Part inspection; Vehicle history; Easy dismantling; Exchange parts in service; Reuse battery	2 nd Life operations	2 nd Life program	<i>“I think about the environment as well but have two operating modes, either I can afford it and consider the environment, if I can't afford it, I have to cut environmental thinking. Scrapping the second-life vehicles that come back to us would be the cheapest, but we remanufacture them on a large scale and try to resell them on a large scale. There is a lot of grey energy in the vehicles, and we can consider a market for people who cannot afford a new expensive vehicle, and we can give them a working vehicle. For example, we have sold 22 second-life vehicles to an eastern European post without an issue for 9 months, now they want to purchase another 60-70” [EV3].</i>
Resell to private customers; Resell to other post markets; As new condition; 2-year Guarantee; Lack of newer features; Lower price	2 nd Life market		
Rusted chassis; Incinerate cladding	Barriers to stewardship in 2 nd Life		
Lack of supplier support; Incinerating batteries; Chemically recycle batteries	State of the art	Battery recycling	<i>“When the batteries return from the customer, they still have a capacity of 75 up to 95 percent. We test them, and if they are still very good, we use them in a second life vehicle. After the second life vehicle use, they can be used in an energy storage, and the theory says that if the capacity of a battery falls below 50%, it is no longer usable and then recycling comes into play. After 50%, they would still work but just use up too much space in most applications and it may no longer be reliable” [EV10].</i>
Take back obligation; Customer request for appropriate disposal; Cost for battery disposal; cost of battery	Financial driver for take back		
Battery recycling process; Material recovery rate; High capacity after 1 st life; Last option after reusing in different use	EoL for battery		
Adapt to environment; Increase Carrying capacity; Extras for different environment; Different settlement structures; Collect environmental data for science; Monitor driving; Change to deliver parcels	Examples of modification	Configurability of vehicles	<i>“The vehicles are adjusted, for example, for 3rd Mail we had to adjust them significantly because the operating conditions are much different. We added a roof, developed a lightweight construction to have a higher volume with less weight, electric locking systems for security reasons, strengthened frames, higher temperature suitability. The regulatory requirements are as well different, and safety is very important there, so we as well added for example a driver emergency button that we developed for them” [EV5].</i>
Co-develop configurations; Standard product with customisation; Transferability of changes	Customisation process		

Table 5-4: Operand resources in customer solution

1 st Order Codes Statements that mention....	2 nd Order Categories	3 rd Order Dimension	Illustrative Quote
Longer lifetime, Less maintenance, Energy efficient	Resource-efficiency	Electric vehicle	<i>The base parameter is that it is advertised for bids open for electric vehicles, so the environmental compatibility is already prescribed. Now we as well have competition, 10 years ago we didn't have any. Then there are more parameters, for example how far can you drive on one battery charge, can you drive up hill under load, does it have a small turning radius, how much mail can be loaded, so how much space do I have and how many kilos can I load? Those are some examples, so there are always many different criterion" [EV1].</i>
Low emission in use, No carbon emission, No noise emission, No petrol allowed in cities	Emission free transport		
Little change in infrastructure, Domestic power supply	Infrastructure	Fleet management	<i>"The benefits at first are not tangible - if you have 50 vehicles or whatever, it is basically the value of knowing how many and which vehicles are on the road, how many and which vehicles are undergoing maintenance, how many vehicles are broken or not moving because they need fixing or have crashed or whatever – so having the data history of your vehicles or Fleet – so that is kind of the value of it. We often say of, say for example, a logistics company – the value of seeing how many vehicles you make money with at any given point in time because if a vehicle moves, you make money, if a vehicle stands, you don't make money" [EV8].</i>
Understanding different terrains and riding styles; Monitor drain on battery; Use on any vehicle	Collect data for development		
Integration of customer and service partner, Increase operational efficiency; Reduce paperwork; customisable	Improve operations		
Measure tilt and other factors; Monitor driving styles	Increase safety and efficiency		
Large haulage volume, Carrying capacity, Durable, Reliable, use in different terrains	Design aspects	Technical properties	<i>"Customers have the initial interest is electric drive and emission free transport. Then there is the use, a small vehicle with a high-capacity ratio. There are only a few petrol alternatives. And with this vehicle class, no matter what drive, it is about optimising the loading capacity. There is only very little direct competition and with the parameters that we offer with 45km/hr and high loading capacity, there is almost none." [EV5].</i>
Energy efficient, Low cost per km, Long range	Efficient vehicle		
Safety, Protection from the elements	Safe use		

5.2.2 Value Proposition

The value proposition defines how a company based on several resources fulfils a customer's need (Osterwalder and Pigneur, 2003). The value proposition refers to the consequential benefits that derive from the use of the products with specific attributes. The post customer buys the solutions, expecting them to provide specified outcomes. In contrast to the resources, the value proposition is more abstract, evaluative, and subjective. It is a bundle of products, services and complementary value-added services for a particular customer segment which describes how a company differentiates from its competitors and seamlessly integrates to solve a customer's specific problem (Bastl et al., 2012; Nordin and Kowalkowski, 2010). Nine benefits in EVCo's sustainable value proposition act as carriers to communicate to the customer how the solution helps to achieve their goals. The study considered value creation for multiple-stakeholder by considering the needs of customers, shareholders, suppliers and partners as well as the environment and society (Bocken et al., 2013). The coding of the value proposition component is presented in Table 5-5.

For the customer. These components in EVCo's solution are:

Adaptable to market changes - The solutions allow changing to adapt to external changes and different use requirements which is particularly helpful for the transition period over the next years until the letter decline/parcel increase has normalised.

Best tool for doing the job - The electric vehicle with its manoeuvrability and specification is the optimal tool for delivering mail and parcels in populated areas. The small vehicle with a high-capacity ratio makes it an ideal tool to efficiently deliver mail and parcels in residential and urban areas.

Cheaper vehicles and spares - Vehicles and parts at the end of their first life are parts that can be recovered, which reduces the cost of new parts and therefor sales cost.

Communication tool - Post companies have ambitious goals to reduce their negative environmental impact. The delivery vehicles are artefacts that is visible to the public and a carrier of that message.

Driver feedback - Understanding the driver's behaviour and giving the delivery personnel instant or delayed feedback on their use of the vehicle and driving style.

Durability of vehicle - The delivery vehicles and their parts are designed and built in a way that ensures durability and guarantees a minimum lifetime of seven years, but in reality, the vehicles run much longer if maintained properly.

Emission-free electric drive - Electric delivery vehicles produce no local emissions such as noise or exhaust gas.

Extended resource lifetime - Wherever possible, the lifetime of resources is extended at the material, part, and assembly level by vehicles that last longer, parts that can be used for multiple life cycles, and materials that are not incinerated after one lifecycle.

Higher productivity - Ability to transport and deliver more units with the same or lower personnel and cost.

Improved vehicles - The vehicles are continuously improved, and the most recent version and updates are sold to the customers.

Low entry barriers - Low technical entry barriers and switching costs to change from petrol to electric delivery vehicles.

Outsourcing responsibility – Transferring responsibility and compliance requirements upstream in the supply chain to suppliers by outsourcing tasks.

Reliability of vehicle - Ensuring a reduced risk of a breakdown of the vehicle and a guaranteed minimum lifetime.

Transparency and predictability of operating cost- Visibility and transparency over the current use of vehicles and future cost and maintenance that will occur in their use phase, enabled through different products and processes.

Table 5-5: Components of EVCo's sustainable value proposition

1 st Order Codes	2 nd Order Categories	3 rd Order Dimension	Illustrative Quote
retrofit and change products, increasing uptime, customisation letter to parcel; monopoly termination; rapid change; fierce competition	Adapt vehicle	Adaptable to market changes	<i>"We developed a four-wheeled electric pedal bike that is like a trolley, but it has like a bike attached to it and then you sit there and pedal. The innovation behind that is that we wanted to develop a low maintenance drive. We are not strong in the bike business, but there is a demand from the posts as they want to have a vehicle that can be driven without a driving licence, for staff without a licence and apprentices under 18 who are not allowed to drive the EV" [EV1].</i>
consumer contact; business-to-business; changes in business	Change in market		
combustion to electro; legislation	Change in consumer behaviour		
increase competitiveness; Technical specifications; Parcel over letter; co-development	Traffic regulation	Better tool	<i>"First, an internal specification sheet is created. Designs are discussed in the team and inputs taken. Very early on in the process, a prototype is built and tested internally. The customer is early on involved and gets the chance to test the prototype by the user and there is a lot of exchange during the development phase with the customer visiting the company to see if it need improvement" [EV8].</i>
		Best tool for doing the job	
change for operating conditions; Customisable; Customer/User involvement; User testing; integrated solution; Form follows function	Customised design		<i>"Our service partners have a catalogue where they order replacement parts but have to return the old part to the company. We inspect them and where possible repair and reuse them" [EV2].</i>
agile in pedestrian areas; different terrain; topography; Different tasks	Versatile use		
Price 2 nd life vehicles	Cheaper vehicle	Cheaper vehicles and spares	
Harvested parts	Cheaper spares		<i>"For an old-school recipient it might not matter, but for the younger generation it does and is increasingly important. They would not understand why a petrol scooter rushes by with only one letter in the box. So, on the one hand certainly to address this demand by the customers, on the other hand we know that the CO2 emission that we reduce with the electric vehicles on the group eco-balance is not significant, but it is one of the measures that each citizen day by day sees. But labelling the vehicles, or as we say, "do good and talk</i>
Repaired service parts	Green branding	Communication tool	
sustainable image; green image good side effect"			
improving communities; exchange with customers; society's trust;	Image		

Table 5-5: Components of EVCo's sustainable value proposition

1 st Order Codes	2 nd Order Categories	3 rd Order Dimension	Illustrative Quote
fair post provider; brand recognition			<i>about it" we add to the positive image of the Post with our services so that certainly is an aspect. We are step by step becoming more sustainable, and we should talk about it. Using green energy to power them was out of discussions, buying electric vehicles and filling them with dirty energy - that equation would not work" [C2].</i>
measure driver environment; understanding driver style; monitor battery drain; predictive maintenance	Understand driving	Driver feedback	<i>"We collect data about how a driver is accelerating and braking and so we can basically analyse the driving style of a driver with a given vehicle. And then the idea is to obviously give someone feedback on his or her driving style – so are you accelerating very quickly, thereby using a lot of energy and then abruptly braking or are you looking ahead much more and easing off the gas to slow down more and so on. So that works for electric vehicles and combustion engines in the same way and with that obviously you can give tips or whatever and combine that with accident data or whatever and then you can look at it from a fleet perspective where you have 100 drivers and they are behaving in a certain way and you can then basically say for instance, statistically speaking we have a bell shaped curve and the outliers in one or other ends of the curve we need to train to drive better or more quickly or whatever" [EV9].</i>
safety alert signal	Safety feedback		
Off road/ rough terrain; extreme weather conditions	Rough use environment	Durability of vehicle	<i>"At the moment we are looking to get about 7 years – so twice the life that we had with the motorcycles. The lifetime of our motorcycles from when we purchase them is around 3½ years and then we would have to replace them and buy new ones and sell them off – so what we were asking for is a vehicle that has the ability to be refurbished and the ability to be reused so we can double that product lifespan and then it becomes more sustainable and we have a good business partner and so that is why EVCo is very important to us in that we constantly look at new opportunities and ways of improving and in most cases how can we make the vehicles we are buying more sustainable for a longer period of time " [C10].</i>
EU regulation	Minimum durability		
Longevity; established product; lasts twice as long as scooter; continuous improvement; quality of components	Longevity		
Inner city regulation	Inner city regulation	Emission-free electric drive	<i>"There are the regulations and legislative driving for an environmentally friendly or sustainable future. For example new laws in the European Union is saying that in public places, for public procurement of logistics freight fleet, 35% of the fleet providing those services needs to be zero emissions fleet – that is also applying on postal and that means that, depending on the timeframe for implementation in each country, that is something that we have to phase in at some point in the near future here as well and all across the EU countries. So of course, these types of legislation and regulations directly influence and</i>
less maintenance required	Low maintenance		
No pollution; more energy efficient; renewable energy	Sustainable delivery		

Table 5-5: Components of EVCo's sustainable value proposition

1 st Order Codes	2 nd Order Categories	3 rd Order Dimension	Illustrative Quote
Customised for longevity; Longer lifetime; Optimal driving; Service operations	Extending product life	Extended resource lifetime	<i>pressure us towards more sustainable operations, including changing our fleet to more zero emissions" [C8].</i>
Reuse parts from maintenance; Part harvest; Remanufacturing vehicles; Reuse batteries; Take back all vehicles	Extending part life		<i>"Every project that we start gets assessed, whether it has a positive, negative, or neutral influence on the ecological assessment of the product. That is sometimes difficult to assess, but it is part of the process. That is an integrated tool in the ERP where we manage the projects and we can create a report that shows how many projects had a negative effect, then I can check the projects and see why that is the case. But important is that the engineer that starts the project is conscious why the project has a negative effect" [EV8].</i>
Model-maintenance-process; Town hall meetings; Supplier collaboration	Development for longevity		
increased efficiency; higher carrier capacity	Efficiency	Higher productivity	<i>"If a post man in the past had a loading capacity of 30kg and had to reload the battery frequently, they had a certain area and once that is done, the shift is over because they had to recharge. Now with our current solution they can load up to 270kg and they can drive on and be more efficient" [EV1].</i>
Customer software interface; digitalising processes	Process optimisation		
longer shifts possible; High uptime; Save time	Time		
Improvements scaled across customers; transfer knowledge between products	Scaling improvements	Improved vehicles	<i>"Most changes are coming out of problems. For example, we had issues with the stability at higher speeds, we were then looking for solutions to make the vehicle wider at the rear to prevent tilting" [EV6].</i>
internal communication; Many inhouse development capabilities; R&D; Supplier collaboration; Analyse user data	Product development		
Build quality; Model care process; Responding to feedback and complaints	Product quality		
Little change in infrastructure; Low switching cost; Standard domestic power plug	Switching cost	Low entry barriers	<i>"We only had to invest little in the infrastructure. I did some calculations and e.g., for the local premises – we didn't have premises for this and for example in the charging facilities for premises we had to make bigger doors for example or make some ramps, and so we had</i>

Table 5-5: Components of EVCo's sustainable value proposition

1 st Order Codes	2 nd Order Categories	3 rd Order Dimension	Illustrative Quote
Low price for second-life vehicles	Investment Cost		<i>to do the electric works and so on and that was a bit more than expected but it wasn't such a problem because with these new devices we are creating a lot of savings" [C7].</i>
Push sustainability requirement upstream; Service partners need to be sustainable; Supplier code of conduct; Supplier regulation conformity; ISO Certification	Sustainability	Outsourcing responsibility	<i>"We have contracts with more focus on the response time in repair and maintenance work, others require measurable availability of something like 98 or 99% of the product lifetime with an algorithm to determine that. It is more a safeguard in case something goes really wrong. I can't recall when these penalties actually have been used. Customers want practically 100% outsourcing. They like to just have a working vehicle the delivery personnel can use and a maintenance contract. The maintenance fee equals to around 10-15% of the investment per year" [EV5].</i>
Service partners uptime; Vehicle uptime with provider	Uptime		
Guarantee of 2 nd life vehicles, Ensured uptime, IoT solution, Less maintenance, Local maintenance partners	Increase reliability in use	Reliability of vehicle	<i>"Because the vehicles are reliable and durable, the downtime compared to competitors is lower. One difference from our electric vehicle to the old Post moped was, that the moped had to be serviced every 500km. Our vehicle needs a service every 5000km, so that already means that the downtime is much lower because of the fewer services" [EV1].</i>
Continuous improvement, Model-maintenance process	Continuous improvement of reliability		
All service operation in ERP; Replacement vehicles; Maintenance cost; Increase of cost towards EoL	Transparency for provider	Transparency and predictability of operating cost	<i>"Customers should consider a TCO perspective to purchasing the vehicles, for example, per letter or km driven. This then includes the loading capacity and the reach of the battery, and the cost of additional infrastructure required. For example, a larger reach on a battery charge requires fewer charging hubs and depots. Unfortunately, many do not calculate that way and require a cheap purchasing cost" [EV1].</i>
Flat fee for customer; Vehicles sold as a whole; TCO per letter; Transparent energy cost; Knowing which vehicle is on the road	Transparency for customer		
Model maintenance process; Data from service contractors	Predicting cost		

5.2.3 Sustainable Customer Value

The analysis of both official company documentation and interviews with respondents involved in goal setting confirmed that the outcomes their organisations want to achieve are increasingly influenced by stakeholders from both within and outside of the business relationship. Goals are guided by institutional logics and are the ultimate end states customers want to achieve through the integration of resources. Within economic, social, and environmental goals, the study identified eight ViU constructs representing the top of the means-end hierarchy. The data revealed that the achievement of social, economic, and environmental goals have a clear hierarchy of importance, with social goals being the most important and environmental goals being the least relevant to achieve. The coding of the ViU constructs is presented in Table 5-6.

Value-in-use constructs to achieve economic goals

Availability - EVCo's customers require solutions that ensure the availability of their fleet in different environments and for different uses when they need them. Availability is particularly important considering changes in the market as letter volumes decline and parcel volume increases. This change further requires the customer to be more flexible in the ways it delivers services.

Grow business - The postal companies are all self-financing and are expected to return a profit to the owning governments by offering superior customer value. Increasing the revenue and top-line growth by offering new and/or better services to the end customers with delivery vehicles that are tailored to adjust to the operational environment is vital to sustaining growth.

Lower cost - The universal service requirement on letter delivery, with monopolies in the letter business are no longer the primary sources of revenue for post companies. The parcel delivery business is hugely competitive. Post companies delivering parcels operate in fully liberalised and cost-driven markets that require keeping operations efficient. Investment, switching, operating, and maintenance costs must be kept as low as possible to make the solution affordable.

Value-in-use constructs to achieve social goals

Corporate citizenship - The post companies see themselves as community builders and connectors who operate ethically and sustainably and try to not impact society at large negatively through their operations. Because post companies are government-owned, they have a role model function. This is why they set a focus on sustainable driving, decreasing exhaust emissions, energy efficient buildings, and obtaining their electricity from natural renewable sources.

Safer vehicle use - Assets are designed, build, maintained, and operated to ensure that the driver and other participants in traffic, as well as the goods delivered, are as safe as possible. The reduction of injuries and employee safety is of the highest importance for all companies. Driver safety was not an issue for many years but has become very important in recent years, and the vehicle class offered by EVCo is statistically significantly safer than two-wheeled petrol alternatives.

Value-in-use constructs to achieve environmental goals

Reduced resource consumption in use - Solutions keep the consumption of energy and consumables during the use phase as low as possible. The companies are interested in how they can use data about the routes and terrain to drive with the least impact.

Reduced resource consumption in production - Customers have an interest in ensuring that their suppliers keep the resource consumption for the production of new vehicles as low as possible.

Reduced resource leakage and waste at the end of life - Minimising leakage of resources and waste at the EoL is important to post companies and they take different approaches to doing so. Measures include developing energy storage from 2nd life vehicles in one of their facilities to store photovoltaic energy.

Table 5-6: Value-in-use constructs for goal achievement

1 st Order Codes	2 nd Order Categories	3 rd Order Dimension	Illustrative Quote
<i>Economic goals</i>			
Agreed operating life; Contractual ensured uptime; Fleet availability; supplier with ongoing support	Contract	Availability	<i>“The customers will demand ever-higher uptime of their products and longer routes, so the product-service mix has to adapt accordingly” [EV2].</i>
Reliable service network; Move service into the night; Low response time; Seamless maintenance integration; Part availability	Services		
Reliability and durability; longer operating times possible; Working in different harsh environment; Less maintenance and replacement	Delivery vehicles		
Embrace letter business; New business models; new business-to-business-to-consumer business models	Business models	Grow business	<i>“My driver is to bring in new business into 1stMail and can show our stakeholders and owners, the government and population, that we are still providing meaningful services to all citizens. And so that would be the perfect combination of creating new business and a new positive image and public relationship because circular economy business models always engage the business customers and the private customers, which is very positive” [C6]</i>
Parcel business; Changing market; Growth in E-commerce; Enable light parcel delivery	Market		
Role model company; Sustainable brand image	Image		
Increase competitiveness; Become more efficient; Customer integration in maintenance; Reliable partner who understands needs; Automated processes; Cost saving in processes	Increased efficiency	Lower cost	<i>“We work in a completely open market so there is no monopoly for us when it comes to parcels – so that becomes a little bit of a strain on the business. But we are finding ways or continue to look for ways that continue to embrace the letters business in combination with the parcels because that’s where the trikes have tended to come in with us - with that transition from what it was to what it needs to be over the next 5 – 7 years” [C10].</i>
Less energy in the use phase; Lower operating cost; low TCO; Flat fee maintenance; High-cost predictability and transparency; Less vehicle changes; fleet on the road; Reduce failure rate	Operating cost		
Cheaper 2 nd life vehicles; Low switching cost; Amortisation rate	Investment cost		

Table 5-6: Value-in-use constructs for goal achievement

1 st Order Codes	2 nd Order Categories	3 rd Order Dimension	Illustrative Quote
<i>Social goals</i>			
Expectations from government/owner; Connect communities; Additional services to citizens; Do good and talk about it; No emissions and sound pollution	Role model company	Corporate citizenship	<i>“We are trying to set some standards in relation to reduced emissions and so forth and what we are trying to do is, like a lot of large organisations, and we want to be a good community partner and so what we are trying to do is make sure that across all of the different things we are trying to do are balanced choices” [C10].</i>
Code of conduct; Minimum wages for suppliers; ISO certification requirement	Ethical corporation		
Protect employees from elements; Safer than two wheeled vehicles; Reliable high build quality; Safe to use on icy roads; Reducing work injuries	Safer mode of delivery	Safer vehicle use	<i>“The safety of our people is our number one priority ... we are committed to creating workplaces where everyone feels safe and well in the course of their day” [C11].</i>
Monitor driver’s behaviour; Training	Safer driving		

Table 5-6: Value-in-use constructs for goal achievement

1 st Order Codes	2 nd Order Categories	3 rd Order Dimension	Illustrative Quote
<i>Environmental goals</i>			
Longer lifetime; Harvested parts to reduce resource use in maintenance; Predictive maintenance	Exploiting resources	Reduced resource consumption in use	“The post customer defines the specification. If it is advertised for electric vehicles, environmental compatibility is already prescribed” [EV1].
Climate neutral deliver, Renewable energy for use; Efficient mode of transportation	Electric drive system		
Measure consumption based on driving style; optimise braking/accelerating	Reduce energy consumption		
Harvested parts from 2 nd life; 2 nd life vehicles; Remanufacturing; Battery recycling	Reduce resources per vehicle	Reduced resource consumption in production	“In the field of responsible procurement, we worked with an external CSR and rating agency and encouraged our 300-400 suppliers to be accredited by them [the rating agency] as a means to increase further the transparency in the supply chain” [C2].
Better build quality reduces amount; Longevity/durability	Reduce vehicles needed		
Supplier Audit; ISO certification; continuous improvement; Code of conduct	Continuous reduction		“We have different EVs and with the electric storage project we wanted to make a statement that we care about sustainability and that the end of life batteries sooner or later will become an issue was kind of clear to us. So, we could not just lean back and push it to the supplier. It is about taking on that and it is not only this supplier. If we look at the carbon footprint of our company, 80% falls on mobility. E-mobility will come in all sectors, and we just started with the small delivery vehicles but that will sooner or later become an issue anyways” [C3].
Battery reuse; Battery recycling	Battery	Reduced resource leakage and waste at the EoL	
Possibility to refurbish; Take back end of life; Remanufacturing; Part harvest	Remanufacturing		

5.3 Means-End Chain Analysis

A means-end chain analysis as described in Section 3.5.3 was conducted to understand how resource integration leads to the creation of sustainable value in CS. Means-end chains explain the hierarchical relationship between the attributes of a CS, the benefits they offer, and the value for the customer.

In this part of the analysis, means-end chains are built. The terminology of *attributes*, *benefits*, and *value* that is traditionally used in means-end chain analysis was adjusted to the empirical context of this study. The attributes are represented by the integrated resources, the benefits by the value proposition, and the value by the ViU. This allows to identify how the attributes of integrated resources, through value propositions which communicate the benefits, lead to the creation of ViU for the customer.

The study used an Association Pattern Technique, which uses two matrices, an attribute-benefit matrix and a benefit-value matrix (Vriens and Ter Hofstede, 2000) to identify means-end chains in the data. The matrix coding function in Nvivo12, which allows exploring the intersections between data coded with multiple categories, was used to identify the means-end chains.

First, the data was analysed with a matrix of *Resources* and *Value Propositions* and a matrix with *Value Propositions* and *Value-in-use* which allowed identifying passages in which informants talked about how the attributes of the solution lead to benefits, and how benefits lead to value. Then, the relationship function in Nvivo12 was used to establish relationships between each mentioned attribute, benefit and value and coded the intersection accordingly at those relationships. In the next step, the matrix coding function was used again to explore the intersections between the data that was coded at the relationships *Resources lead to Value Proposition* and *Value Proposition leads to Value-in-use*. As a result of this multi-stage coding process, it was possible to reliably ground the means-end chains from attributes to benefits, to values in the data.

The means-end chains were then distinguished between operand and operant resources. For the identification of the means-end chains, the operand resources were regarded as focal, and an analysis of which operant resources work on the operand resources was conducted. The analysis revealed 127 means-end chains of which evidence how operand resources, value proposition components, and ViU are linked. These are described with the sum of all numerical values in Table 5-7 that are from operand resources.

To increase the validity of the in-depth analysis, only means end-chains which were reported at least twice were considered to highlight the most important ones. This resulted in 83 means-end chains, which are the ones with greyed out values in Table 5-7. For example, three means end chains were identified how the configurability of vehicles (operand resource) lead to be adaptable to market change (value proposition component) and how that leads to growing business (ViU).

The findings were graphically interpreted to better understand the intertwined relationships of resources, value proposition components, and value-in-use. Figure 5-2 presents an overview of how the six operand resources lead to benefits and ViU. The thickness of the line indicates how many times the means-end chain was mentioned by respondents. The thicker the line, the more occurrences. The numbers at the bottom of the figure indicate how many means-end chains are created by the respective resource. The following subsections describe these selected means-end chains which are presented in Figure 5-3 to Figure 5-8.

5.3 Means-End Chain Analysis

Table 5-7: Means-end chains around value proposition components

Benefit to customer	Attribute **	Value in use								
			Availability	Grow business	Lower cost	RRC in production *	RRC in use *	RRC at EoL *	Safer vehicle use	Corporate citizenship
Adaptable to market change	Configurability of vehicles	-	3	2	-	-	-	-	-	-
	Fleet management	-	-	-	-	-	-	-	-	-
	Technical properties	-	3	2	1	-	1	-	1	-
	<i>Solution Contracting</i>	1	1	1	-	-	-	-	-	-
Best tool for doing the job	Configurability of vehicles	3	2	2	-	-	-	3	-	-
	Electric vehicle	-	-	1	-	1	-	1	1	-
	Fleet management	-	-	1	-	-	-	-	-	-
	Technical properties	6	1	4	-	-	-	5	2	-
	<i>Culture</i>	-	1	-	-	-	-	-	-	-
	<i>Expert knowledge</i>	1	1	-	-	-	-	1	-	-
	<i>Relationships</i>	1	-	1	-	-	-	-	-	-
	<i>Solution Contracting</i>	-	-	1	-	-	-	-	-	-
Cheaper vehicles and spares	2nd life program	2	-	1	1	1	-	-	-	1
	Electric vehicle	-	-	1	-	-	-	-	-	-
Communication tool	Battery recycling	-	1	-	-	-	-	-	-	-
	Electric vehicle	-	5	-	-	-	-	-	-	1
	<i>Compliance</i>	-	1	-	-	-	-	-	-	-
Driver feedback	Configurability of vehicles	-	-	1	-	1	-	1	-	-
	Fleet management	-	-	-	-	2	-	3	-	-
Durability of vehicle	Configurability of vehicles	1	-	-	-	-	-	-	-	-
	Electric vehicle	-	-	1	1	-	1	-	-	-
	Technical properties	3	-	-	1	-	1	-	-	-
	<i>Continuous improvement</i>	1	-	-	-	1	-	-	-	-
	<i>Compliance</i>	2	-	-	1	-	-	-	-	-
Emission free electric drive	Electric vehicle	-	2	1	-	3	-	-	2	-
	Technical properties	-	1	-	-	-	-	-	-	-
Extended resource lifetime	2 nd life program	-	1	1	3	-	2	-	1	-
	Battery recycling	-	-	-	2	-	3	-	-	-
	<i>Continuous improvement</i>	1	-	-	2	-	-	-	-	-
	<i>Expert knowledge</i>	-	-	-	1	-	-	1	-	-
	<i>Compliance</i>	-	-	-	1	-	1	-	-	-

* RRC stands for 'reduced resource consumption'

** Attributes in roman are operand resources, attributes in italics are operand resource

Table 5-7: Means-end chains around value proposition components

Benefit to customer	Attribute **	Value in use							
		Availability	Grow business	Lower cost	RRC in production *	RRC in use *	RRC at EoL *	Safer vehicle use	Corporate citizenship
Higher productivity	Configurability of vehicles	-	-	2	-	-	-	-	-
	Fleet management	-	-	2	-	-	-	-	-
	Technical properties	-	-	5	-	-	-	-	-
	<i>Expert knowledge</i>	-	-	1	-	-	-	-	-
	<i>Relationships</i>	-	-	1	-	-	-	-	-
Improved vehicles	Configurability	-	-	-	-	-	1	-	-
	Technical properties	1	-	-	-	-	2	-	-
	<i>Continuous improvement</i>	1	-	-	1	-	1	-	-
	<i>Expert knowledge</i>	-	-	-	-	-	1	-	-
Low entry barriers	2 nd life program	-	-	2	1	-	-	-	-
	Electric vehicle	-	-	2	-	-	-	-	-
Outsourcing responsibility	Battery recycling	1	-	1	-	-	1	-	-
	<i>Culture</i>	-	-	-	-	-	-	-	1
	<i>Expert knowledge</i>	2	-	1	-	-	-	-	-
	<i>Relationships</i>	3	-	1	-	-	-	-	-
	<i>Solution contracting</i>	7	-	1	-	-	-	-	-
	<i>Compliance</i>	-	-	-	-	-	2	-	1
Reliability of vehicle	Configurability	1	1	-	-	-	-	-	-
	Fleet management	1	-	-	-	-	-	-	-
	Technical properties	1	1	-	-	-	-	-	-
	<i>Continuous improvement</i>	2	-	-	-	-	-	-	-
	<i>Expert knowledge</i>	1	-	-	-	-	-	-	-
	<i>Solution contracting</i>	5	-	-	1	-	-	-	-
Transparency and predictability of operating cost	Electric vehicle	-	-	1	-	-	-	-	-
	Fleet management	1	-	-	-	-	-	-	-
	<i>Continuous improvement</i>	1	-	-	-	-	-	-	-
	<i>Solution contracting</i>	4	-	-	-	-	-	-	-

* RRC stands for 'reduced resource consumption'

** Attributes in roman are operand resources, attributes in italics are operand resource

5.3 Means-End Chain Analysis

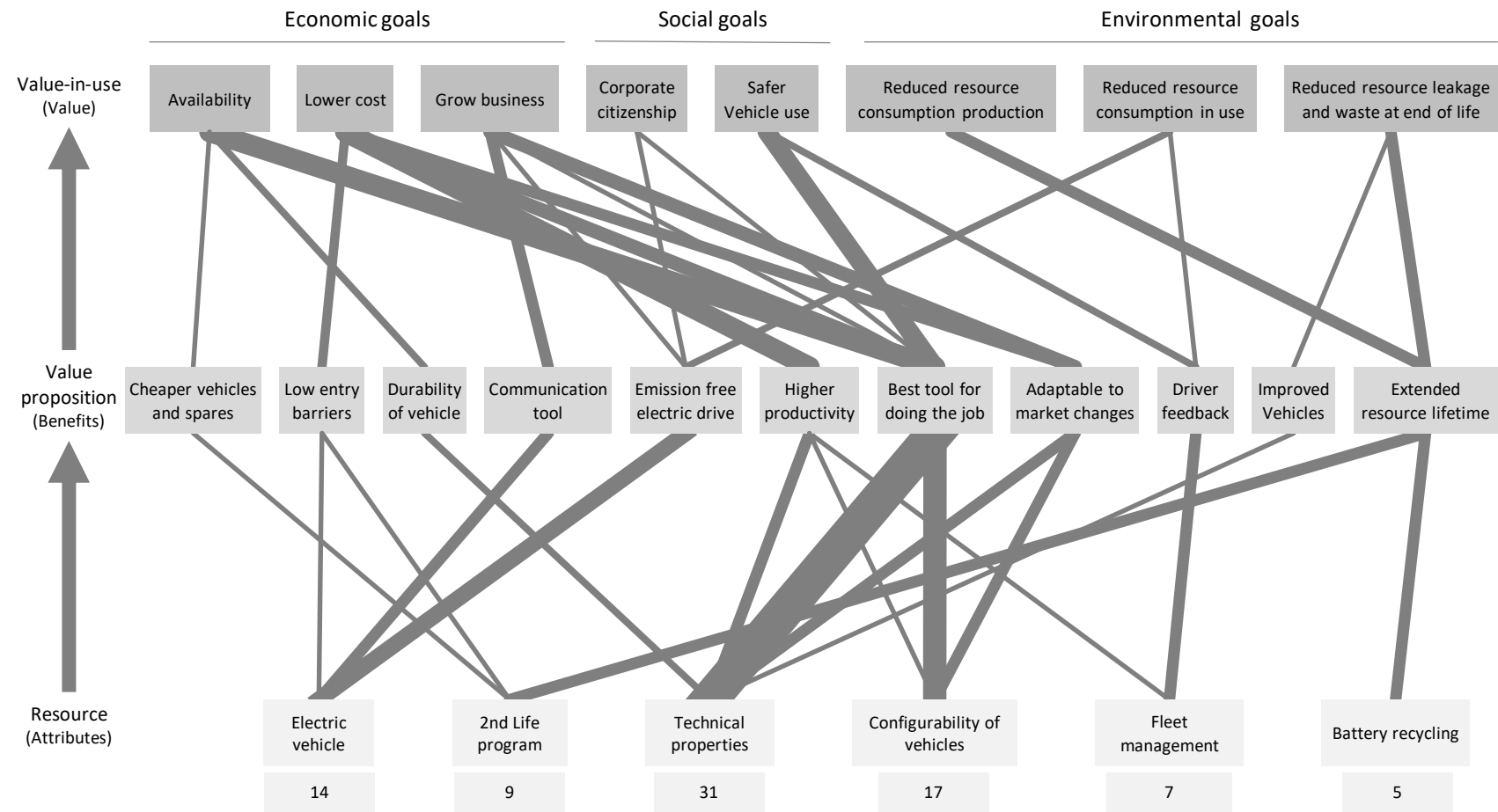


Figure 5-2: Identified means-end chains in the solution

5.3.1 2nd Life Vehicles

EVCo seeks that all customers, including private ones, return their vehicles so that they are not unprofessionally disposed of and can, where possible, be used again in a second life. These vehicles go on a test rig to assess how they are performing and see what could be wrong mechanically and test the electrical capacity of the battery. EVCo gets the vehicles with the original registration papers and remanufactures them using the same chassis number in their ERP. With the 2nd life vehicles that are used for part harvest, EVCo manages to ensure the availability through cheaper spares. With the vehicles that are remanufactured and sold to both private and business customers at around 40% of a new vehicle, the company lowers the entry barriers and by doing so lowers the cost for the customer, which allows them to achieve their economic goals.

The 2nd life vehicles significantly extend the resource lifetime both in the beginning and the EoL vehicles. On one hand, the vehicles need fewer materials in production. In some cases, only the cladding has to be replaced, and on the other hand, the leakage of the resources out of the economic system is reduced as the parts get harvested and remanufactured. By doing so they help achieve the environmental goals of both EVCo and their customers.

The parts are harvested, stored, and the chassis is recycled. And that works well. I am myself surprised how many of the parts can be reused. So, we can almost with zero material cost remanufacture the vehicle. [EV5].

The major operant resource for the 2nd life vehicles is solution contracting, which allows the EVCo to plan their remanufacturing operations because they know when and how many vehicles will return for remanufacturing. Because the company has the entire service history through the service contracts, they further know exactly what has previously been repaired or any other issue with the vehicle.

Figure 5-3 depicts the means-end chains for EVCo's 2nd life program. The numbers in the graph next to the lines indicate the numeric value of how often the means-end chain occurred. Further, the passages that were coded at both operand and operant resources

were analysed to describe how operant work on operand resources. The very bottom of the graph represents the operant resources which work on the operand resources.

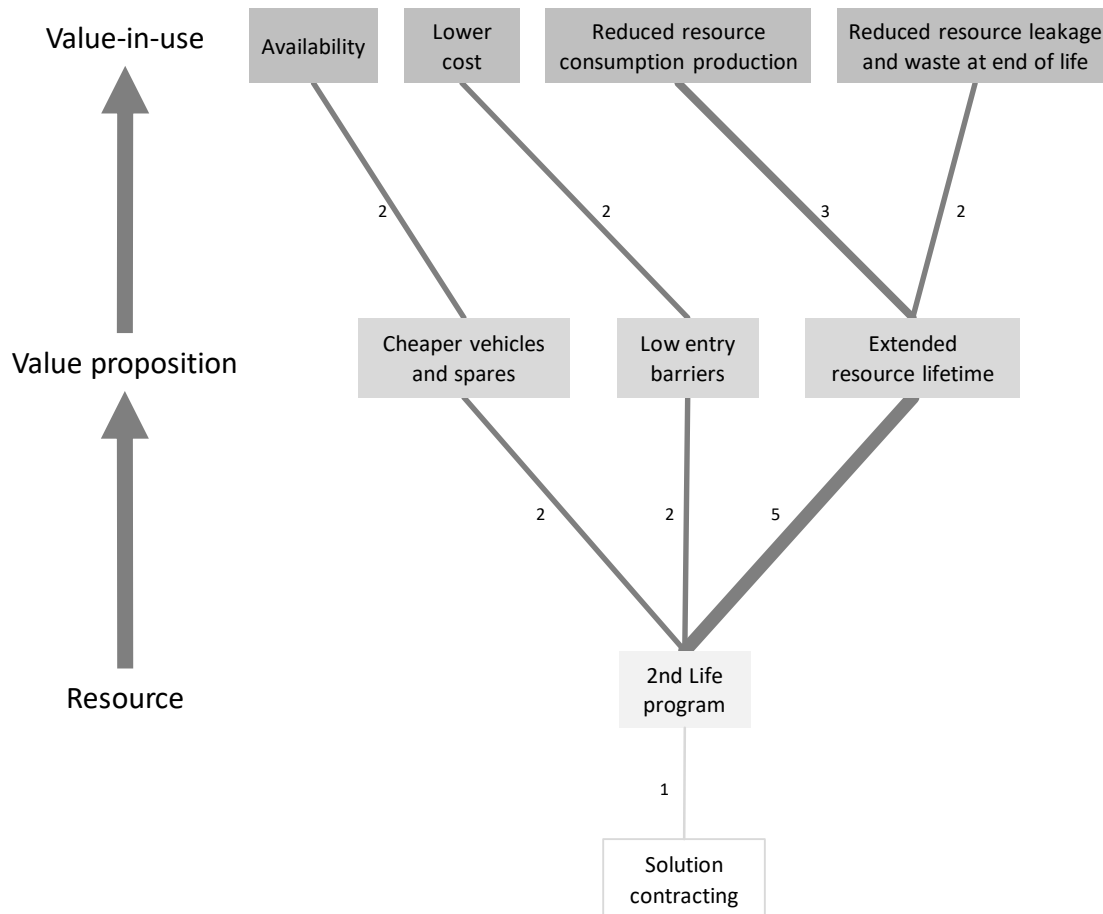


Figure 5-3: Integrating 2nd life program

5.3.2 Battery Recycling

As a distributing company of the batteries, EVCo has the legal obligation to take them back at EoL. This is why the company developed a recycling process. The development and scaling of EVCo's battery recycling leads to extending the resource lifetime as part of the value proposition, which helps EVCo and their customers to achieve two environmental goals. First, the reduction of resources in production and second, the reduction of leakage and creation of waste at the end of the batteries' life. Typically, these would be sent to a recovery company and first are shredded and then heated, and in this

process, some materials are recovered. The novel mechanical recycling process is a promising alternative to the current state of the art, which is more energy intensive, requires chemicals, and has a lower recovery rate.

*Our approach is to separate the components instead of shredding them...
Currently, we have a recovery rate of around 92-95% of the materials that
we get back. [EV10]*

EVCo's goal is to involve the suppliers and close the loop entirely by producing new batteries out of the recovered materials with the same energy density and quality as one from virgin materials and by doing so reducing the requirement for virgin material in the production. Compliance is a relevant factor in the development of the battery recycling process, as, on one hand, the company must comply with the regulation that requires them to take the batteries back at the EoL, on the other hand, because the process of recycling is dangerous and requires the handling of hazardous materials. More important than compliance is EVCo's culture which acts as the main enabler and driver for the development of various sustainability projects.

EVCo has a strong culture, supporting sustainability and innovation, much of which represents the founder's personality. EVCo's founder and owner is always on the search for answers and better solutions, shape the processes in the company and supports both efficient and sustainable operations, such as in the development of the recycling process.

We see ourselves as a very sustainable company and have it in our mission statement, and it is a matter of great importance to the owner. We have many ongoing sustainability-related projects, such as the second life project, then we have the battery recycling where we are in contact with the Chinese suppliers, and of course, we have pressure from our customers, who request that we are sustainable. [EV2]

Figure 5-4 depicts the means-end chains for EVCo's battery recycling program, with the two operant resources compliance and culture.

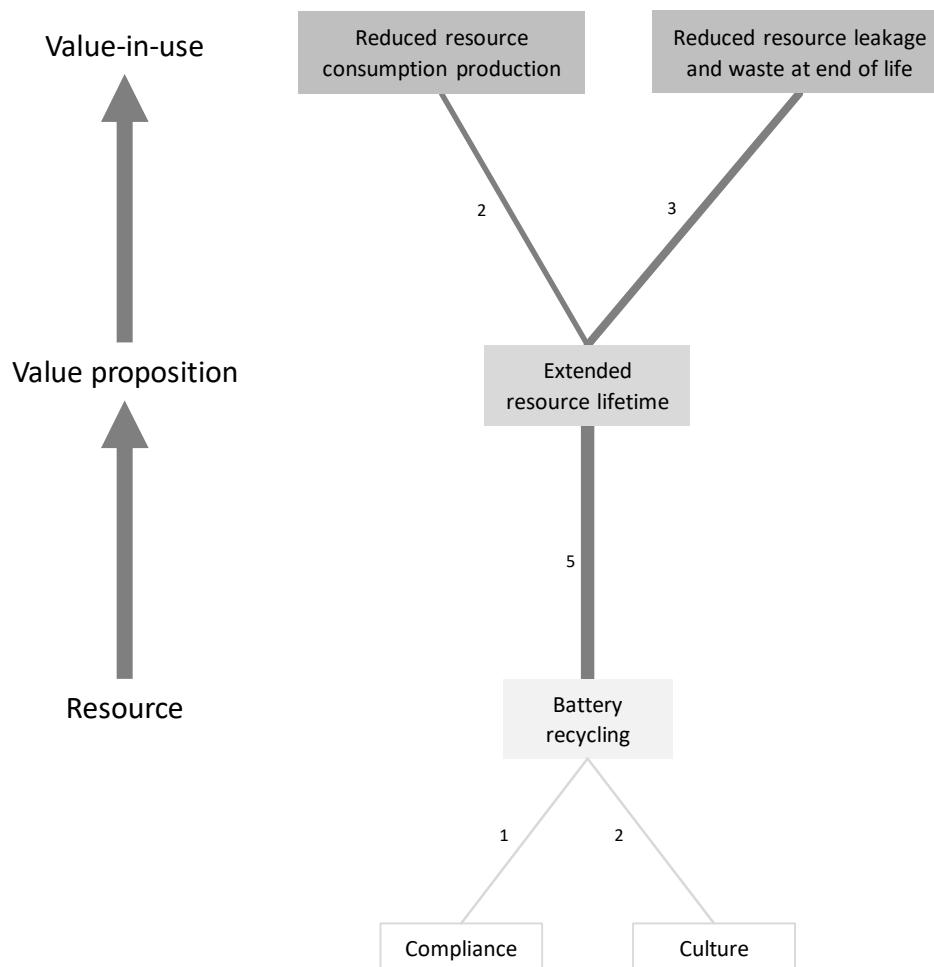


Figure 5-4: Integrating battery recycling

5.3.3 Configurability of Vehicles

The solutions EVCo offers to the customers, in general, are based on existing products. For example, the three-wheeled electric vehicles. But this is always broadened up as there are always customers with specific requirements. No post service buys a standard product, but the base product is standardised and with certain adjustments can satisfy the customer's need. Standardised products would help in lowering the cost but addressing individual customer requirements is more important than standardising lower cost, just because it is the main selling point.

Configurability is one of the most important attributes of EVCo's solutions, leading to a variety of benefits. Configurability makes the vehicles into what was by many respondents referred to as 'the best tool for doing the job', increasing safety and helping customers achieve all three identified economic goals. EVCo's vehicles must protect their drivers all year around, and some of the customers are located in countries with harsh winters and others with extreme heat during the summer.

No post service buys a standard product, but the base product is standardised and with certain adjustments can satisfy the customers' needs. The vehicles are adjusted, for example, for 2nd Mail we had to adjust them significantly because the operating conditions are much different. We added a roof, developed a lightweight construction to have a higher volume with less weight, electric locking systems for security reasons, strengthened frames, and higher temperature suitability. [EV3]

Having the best tool for the job available helps the post companies to achieve their economic goals during the operations. The availability of the vehicles increases, because they are adjusted to the changes in the economic environment. So, it is for example possible to be longer on the road by adding certain features and distinguishing the vehicles from established scooters. The configurability of the vehicles leads overall to an increase in productivity, which helps lower the cost.

We need them to be out there for longer – our postmen and motorcycles are currently out there for around 4 hours a day and we need them to be out there for 6 hours per day, which is possible with EVCo's vehicles. [C9]

The decline in letters and increase in parcel business was one of the most challenging changes in the recent past for post companies. They were in need to adapt to those changes. EVCo's customers were able to configure the vehicles to their advantage and change them over time as the market demand changed. Because of the optimised delivery option with the electric vehicle, the overall cost for the delivery of both parcels and letters can be reduced.

Post logistics are overwhelmed by the number of parcels from all-new e-commerce and post mail has not enough letters.... That required a new solution because on the existing vehicles we had there was only space for letters. They told us we need X amount of litres in volume, and we were able to build a container that is suiting. [EV4]

A broad set of operant resources are required to be successful in offering customised solutions with configurable elements. The company must be at all times aware of the current regulation in the customers' countries and comply with local standards. Overall, the culture within the company helps to understand the customers and find quick and reliable answers to their demands. The engineering team works close with the technicians and the owner encourages innovative thinking.

We have a very pragmatic way of working. We take the customer's idea and wishes, normally through our sales channel, and we then pretty quickly build a prototype or feasibility model within a month or so that stands on wheels and can be touched and tested on a level that the customer can test it. Then we give it to the customer to test and destroy it and if it requires changes or further improvements, we implement them. [EV4]

Likely the most crucial operant resource to successfully integrate the configurability of vehicles is EVCo's expert knowledge. The company through its solutions and different contracts gathers information about the use of its products on a daily base, allowing them to develop products that truly satisfy its customer's needs from small to significant adjustments of their vehicles. EVCo doesn't charge for the development of the different configurations, and by doing so retains ownership over the development and can use them for other customers.

For us, it is as well important that the end-user, in the case of the post the mailman, is at the table when developing solutions. Our motto is that we must address the management. But, in the end, we need to design a product that the postman wants. If the end-user wants it, it will be bought by the higher levels of management. [EV4]

EVCo maintains good relationships with customers, service partners, suppliers, and other actors in the service-ecosystem that are characterised by an exchange of information, trust, and mutual commitments. EVCo is in constant exchange to learn more about how they use the vehicles. Determining what can be improved is partly enabled through solution contracting, which are equipment sales with an added service package or flat fee over an agreed period to ensure long-term service and the consideration of the entire life cycle. The constant exchange as a result of the solution contracting increases the customers' trust in the company's ability to provide the best solution and helps in developing new configurations of vehicles.

I was working together with the post company for a long time and as well got to know the owner well, so the contact was always direct and uncomplicated. Whenever we wanted to do something, EVCo was oftentimes very responsive and helping us with our ideas and the owner was as well always interested in understanding our needs, that maybe at times were a bit special, but they were very uncomplicated and didn't fear to do something new. [C1]

Figure 5-5 shows the means-end chains for the configurability of vehicles. The five operant resources compliance, culture, expert knowledge, relationships, and solution contracting work on the operand resource configurability.

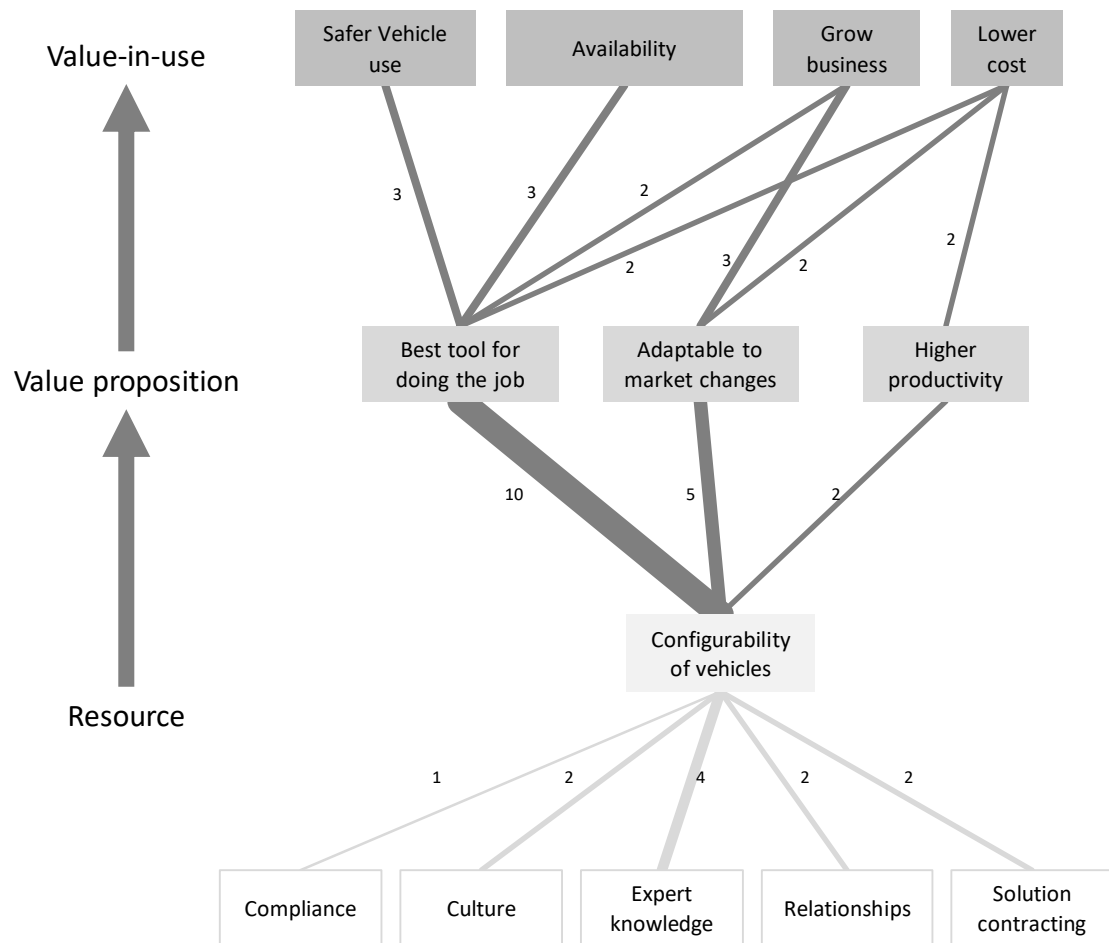


Figure 5-5: Integrating configurability of vehicles

5.3.4 Electric Vehicle

The vehicle's battery-powered drivetrain, as opposed to a combustion engine, represents both technical innovation and a social change from fossil fuels to renewable energy. EVCo's vehicles are inherently better than the older Piaggio and Honda scooters that many post companies used which have two-stroke engines that use 7ltr per 100km in the post service. EVCo's EV use 10kwh/100km. One litre of petrol has 10kwh, about ten times less energy which is, in particular, more sustainable as many customers use certified renewable energies to drive vehicles.

“The base parameter is that it is advertised for bids open for electric vehicles, so the environmental compatibility is already prescribed. Now we as well have competition, 10 years ago we didn't have any. Then there are more parameters, for example how far can you drive on one battery charge, can you drive up hill under load, does it have a small turning radius, how much mail can be loaded, so how much space do I have and how many kilos can I load? Those are some examples, so there are always many different criteria” [EV1].

An environmentally friendly culture within both EVCo and their customers drive the acceptance of electric vehicles as both buyer and supplier find it important to reduce emissions and the use of fossil fuels.

“The vehicles and batteries are sold as one and as well written off as one in the customer's books. The maintenance and operating cost are comparably low to the depreciation, so the TCO is low as well.” [EV5].

The use of electric vehicles is increasingly important and allows delivery companies, as cities ban petrol-driven vehicles, and in order to stay in and grow their business, post companies must switch to alternative drives. The switch to electric vehicles further reduces the use of non-renewable resources in the use-phase and EVCo's delivery vehicles, in particular in comparison to electric scooters, do not create any local noise and exhaust fume pollution.

“The post still has some public responsibility. Being a national representative is part of the image and as well their capital. The trust that customers put into the post and the mailman is curated by that image and the economic foundation for their operation. If that trust would not be that strong, revenues would certainly be lower. Here the sustainability thought plays in as well, that the post doesn't want to harm the people and [wants to] be a role model, which enhances the image of the post and the employees.” [EV5].

Although sustainability is not the primary driver why customers buy EVCo's solutions, the use of electric vehicles that run on renewable resources is an essential communication

tool for Post companies as part of their corporate social responsibility (CSR) strategies and their ambitions to become carbon neutral. The switch to EVCo's electric vehicles poses comparably low entry barriers, as they are charged on the domestic electricity network, which leads to low switching costs.

Figure 5-6 shows the means-end chains for the operand resource electric vehicle, with the operand resources culture, relationships, and solution contracting working on it.

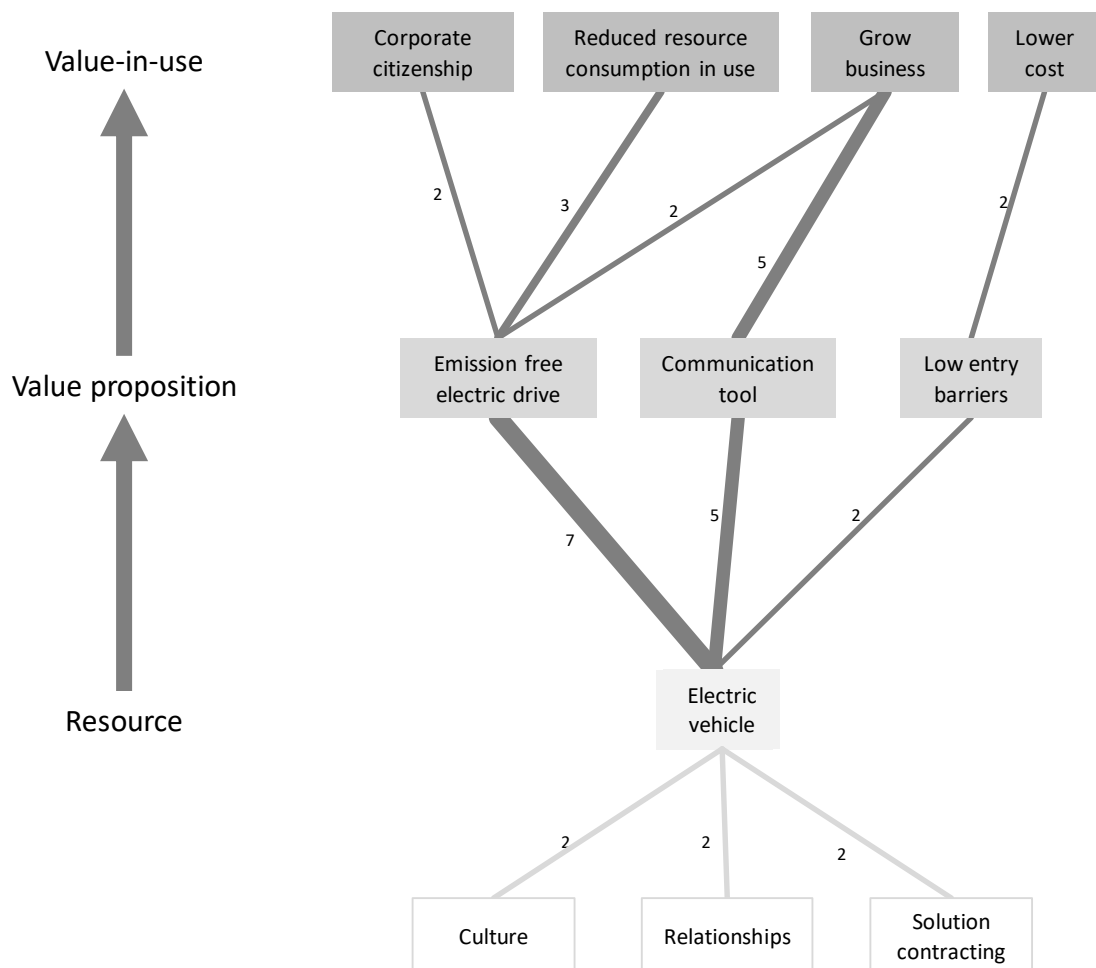


Figure 5-6: Integrating electric vehicles

5.3.5 Fleet Management System

EVCo's in-house developed a digital platform allows monitoring the vehicles' use via remote sensing and plan the fleet's operations. With their solution contracting, EVCo collects data as the basis of their business intelligence. All their processes are represented in the ERP.

“Our external partners have access to our ERP system. So, for example, if they do service work for the customer's vehicles, they log it directly to our ERP with a cost estimate, and we can approve it, and then the service partner conducts the work. That is all browser-based”. [EV8]

Based on the data of users and maintenance, the company has developed extensive expert knowledge on the lifetime and use parameters of vehicles and parts. The huge amount of data that they are collecting sets the foundation for the further development of the solutions.

“One idea is as well to have a lifetime for each component for a certain kilometre or time. It would be part of the system so that we could click the part in the ERP and calculate how long that lasts on average with an algorithm would that runs through all vehicles, and we get the output of X hrs and km. It would be very exciting as we could explore which components have the lowest lifetime and produce even more for longevity”. [EV8]

The fully customisable fleet management system allows to monitor the driver behaviour and vehicle use. By providing instant or delayed feedback to the driver and optimise accelerating and braking, the driving style can be improved which makes the driving safer and reduces energy consumption. The platform is flexible and is not only usable for EVCo's vehicles, but to all vehicles in the customer's fleet.

“For 2nd Mail, we have analysed the driving styles as we had some complaints, not because accidents happened but there was smaller damage, and we could prove that it was the driver that drove too aggressively. And that driving style goes hand in hand with higher energy consumption. Other factors, such as

driving on snow as well add to increased energy consumption. So yes, driving responsibly reduces both the risk of injuries and energy consumption. For 3rdMail, we have increased driver safety through the measurement of acceleration, or we have an emergency button which automatically dials a number. We as well have sensors that measure the tilt, and they automatically send out notifications. We are still developing the feature for the variable acceleration where we can tell the driver if he is driving too aggressively.” [EV8].

The platform allows increasing productivity for EVCo and the customers. Based on data gathered through the solution contracts, EVCo has transparency on all the repairs conducted by third-party partners and has a good understanding of the total cost and can calculate and predict the cost for years, km, or for specific regions and tell how they develop over time. The company creates, based on the fleet management system, statistics per vehicle and how much the TCO is per year, region, and in different environments. Reducing manual data handling using the fleet management system and knowing which vehicles are on the road increases the customers' productivity which ultimately results in lower costs.

“The benefits at first are not tangible - if you have 50 vehicles or whatever, it is basically the value of knowing how many and which vehicles are on the road, how many and which vehicles are undergoing maintenance, how many vehicles are broken or not moving because they need fixing or have crashed or whatever – so having the data history of your vehicles or fleet – so that is kind of the value of it. The value of seeing how many vehicles make money at any given point in time, because if a vehicle moves, you make money, if a vehicle stands, you don't make money. We started doing predictive maintenance, we want to do that much more intensely, especially with our fleet monitoring in which we get the telemetric data from the vehicle. The goal is to read the data and inform the service partner or driver that they should bring the vehicle [in for service] this week, otherwise you'll risk a breakdown” [EV8].

Figure 5-7 depicts EVCo's fleet management system as an operand resource, leading to seven means-end chains. The operand resources expert knowledge and solution contracting are working on the operand resource fleet management.

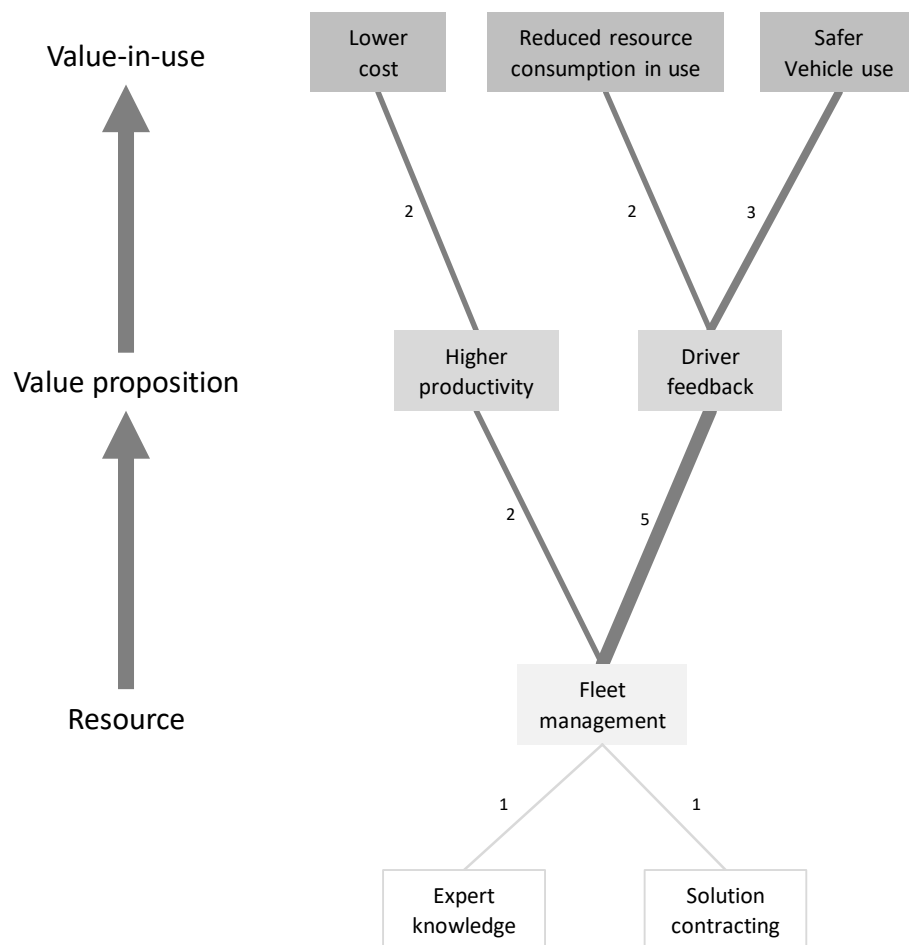


Figure 5-7: Integrating fleet management

5.3.6 Technical Properties

The relationships between EVCo and its customers goes hand in hand with both their own and their customer's expert knowledge. The company invests considerably in research and development of the ideal electric delivery vehicles and has extensive collaboration with the customer, which in turn increases their knowledge. The in-depth understanding

of the customers' needs and use of the vehicles by the end-user combines with both internal and external technical knowledge of the products. The company has no strong vertical integration and focuses on engineering and assembly, certain engineering tasks, especially the ones which require expert knowledge. Aspects such as braking systems are regularly outsourced, and the company as well is exchanging with their suppliers to both develop new and optimise existing equipment.

"We develop the adjustments to the product together with the customers and normally don't charge the customer for that. By doing that, we can retain the intellectual property of the developments and that can feed into the regular vehicles. There are many examples, such as ergonomic adjustments to the handlebar. For 3rd Mail, we had the roof that we developed for protection against the sun, more comfortable seats, and electric locks as examples".
[EV8]

If customers decided to procure L2E class vehicles, EVCo is the best one for their use, given the capacity and agility. The specification of the vehicles that describe their technical properties and make them comparable to competitors' products in tendering processes are unique to EVCo. The changes that the company develops for customers are fed continuously into the development and improvement of existing fleets.

"Customers have the initial interest in electric drive and emission-free transport. Then there is the use of a small vehicle with a high-capacity ratio. There are only a few petrol alternatives. And with this vehicle class, no matter what drive, it is about optimising the loading capacity. There is only very little direct competition and with the parameters that we offer with 45km/hr and high loading capacity, there is almost none." [EV5].

Because of the technical specifications, EVCo's vehicles have been described by respondents simply as the best tool for doing the job and their configurability leads to an increase in availability, business growth, safety, corporate citizenship, and lower costs. The adaption to the operation environment ensures that the vehicles are suitable to, for example, operate in extreme heat or on snow. This increases the availability for the

customer and the safety of the driver. EVCo's striving for quality and ethical manufacturing is supported and encouraged by regulations and standards.

"The Chinese approach is they have a planned lifetime of one year. After one year they are rusted through, in fact they are rusting already at the point of sale. The battery is cheap and just no longer works after using it for a year and everything breaks down. Now such a vehicle wouldn't stand a chance to be accepted in the EU under the new rules for a minimum durability and I think that is a good trend, so manufacturers are already legally obliged to consider that" [EV1].

The vehicles allow to not only deliver three to four times the weight capacity of traditional delivery such as bicycles or petrol scooters but as well to transport a much higher volume to address changes in the market environment towards an increase in parcel delivery. The design of the three-wheeled vehicles with an electric drive increases the safety of the driver because of increased stability as opposed to a scooter. Society at large benefits, as no local emissions are created, and the vehicle is at a lower risk of participating in traffic, especially in narrow urban areas in which increasingly combustion engines are prohibited. The modularity and configurability of the vehicles allow them to be adaptable to changes in the markets and be more productive, which leads to a lower operational cost for the customer.

"We not only offer the vehicles but as well the trailers. An example that is currently running is that a customer had the wish to have more volume in the trailer. Now there are different variants, we decided to build it higher and started running trials with the existing design and what it means for the handling if the trailer is 20cm higher and has a larger tarpaulin. That is a very simple example, but we are able to produce a prototype in a very short time and just give it to the customer for testing ... That is a very simple example how you become a solution provider. It sounds like rocket science, but it is not" [EV2].

The company engages heavily with their customers to get a deep understanding of the market and how the delivery personnel use their vehicles. To ensure the availability of their customer's fleets, EVCo builds and maintains a service network in countries they are active in and only delivers to where they can provide appropriate service. The continuous technical improvement ensures that the base model vehicles are always on the latest updated versions, and future deliveries are improved. The internal process ensures to have the right quality standard on all new vehicles and is as well a place to discuss the total cost over the lifetime of the vehicles as there is transparency as to which parts lead to which costs, based on the data from the service partners and thousands of vehicles, used six days a week, help to calculate the total cost of ownership. These improvements reduce the downtime of the vehicles by reducing breakdowns and failures, as well as reducing the requirement of resources in both production and waste. Customers benefit from more durable vehicles which increases the uptime of the vehicles, and by doing so increases availability for use which is as well enabled through the development cycles of the solution contract.

“For 3rd Mail we initially had a small pilot, in which they tested the vehicles of one year, the specific requirements were defined and that resulted in a small order of 50 vehicles. Based on that test, more experience was collected, that was then implemented in the batch for another 100. After that, the tendering process for the large fleet of 1000 vehicles was public. That started in 2016, so you can see it's about 3 years until the large order came” [EV5].

The technical properties are particularly important as they comply with local and international standards, such as ISO9001 and ISO14001, which dictates certain processes for the company but as well sets benchmarks for what is expected from service partners and suppliers. Customers in an open tender require proof of sustainable practice which flows down to EVCo's suppliers who have to obtain a certain standard and the company visits and audits their suppliers to ensure upstream sustainability.

Figure 5-8 shows the very relevant operand resource of technical properties. Five operand resources, compliance, culture, expert knowledge, relationships, and solution contracting are working on technical properties.

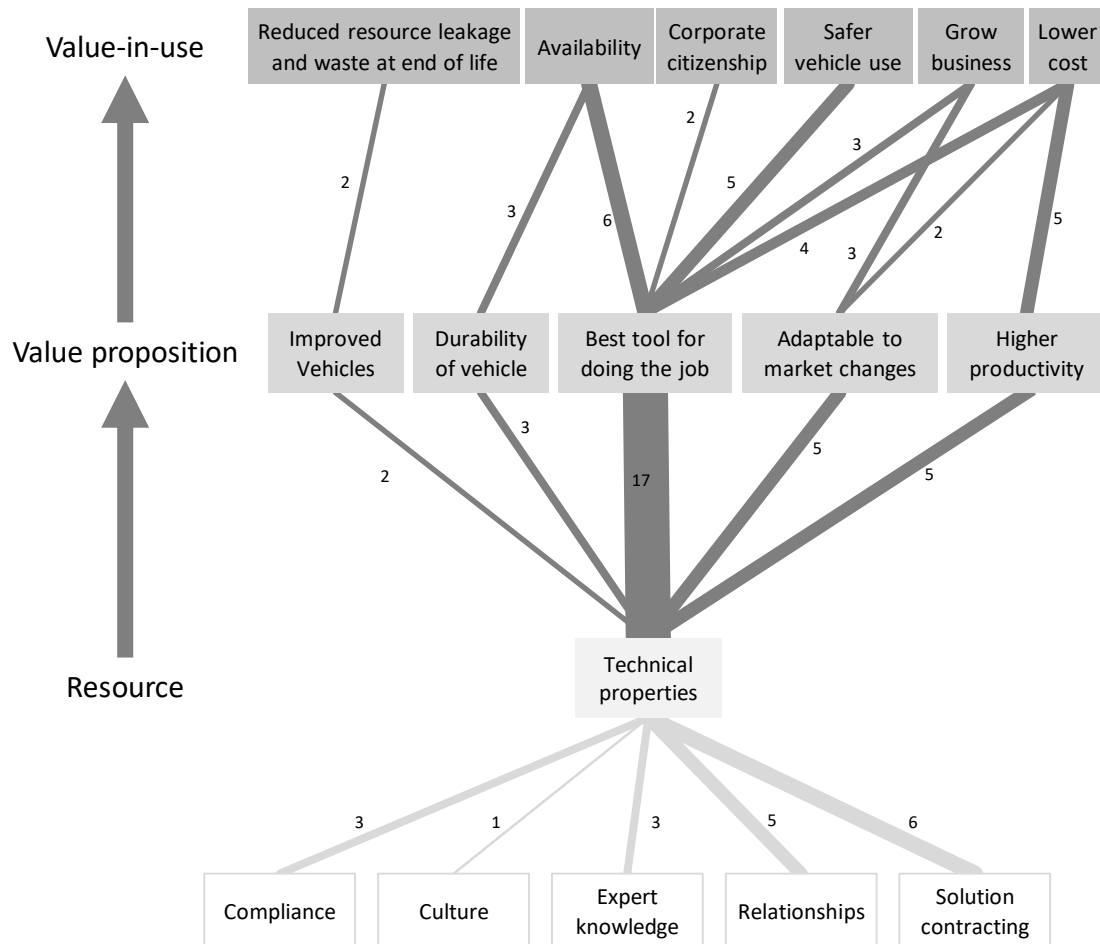


Figure 5-8: Integrating technical properties

5.4 Single-Case Study Findings

5.4.1 Resource Integration for Sustainability

RI comprises the methods through which resources are integrated and used by actors, and consists of cooperative and collaborative processes between actors, leading to benefits as outputs and value as experiential outcomes for all actors involved. That in turn will allow achieving the actors' goals. The study identified six operant (compliance, continuous improvement process, culture, expert knowledge, relationships, solution contracting) and six operand resources (2nd life program, battery recycling, configurability of vehicles,

electric vehicle, fleet management, technical properties) which are integrated into EVCo's solution business. The analysis of the data confirmed that operant work on operand resources, and these resources have different roles in developing more sustainable value propositions.

A total of 83 means-end chains were mentioned. In terms of frequency, the Technical Properties of the vehicle lead with 31 mentions to the means-end chains, followed by configurability of vehicles with 17 mentions and electric vehicle with 14 respectively. The 2nd life program, fleet management and battery recycling, all have less than 10 mentions. Further, the analysis was limited to resources provided by the solution provider. To understand the full complexity of the value creation process, the customers' resources such as knowledge of the market, the daily use of the equipment, and the staff and infrastructure would need to be considered as well.

Interestingly, the operant resource continuous improvement was not identified as relevant enough in the means-end chain. A major criterion of relevant integrated resources is that they lead to the achievement of all three goals to be sustainable. Only three of the six operand resources were found to help achieve all three goals, - electric vehicle, technical properties, and fleet management. Two resources only lead to the achievement of two goals. The configurability of the vehicles only leads to the achievement of social value and economic goals, the 2nd life Program only to environmental and economic goals respectively. EVCo's battery recycling only leads to the achievement of environmental sustainability.

The service ML in EVCo's solution business is most prominently represented by two operant resources (relationships and solution contracting) and two operand resources (2nd life program and fleet management). Although all resources are crucial for the success of the solution business, these four are in particular characteristic for the change from a product to a service ML. The operant resource, solution contracting, interestingly contributes strongly to the profitability goals but not to the other two goals. This indicates that a driver for changing towards a service ML is the economic benefit, and not increasing stewardship practice.

A good relationship with the customer goes hand-in-hand with the successful solution business to co-produce value propositions that mix operand and operant resources as no one resource alone is sufficient for goal achievement. The findings further suggest that solution contracting drives the development of existing ideas, and that culture and relationships facilitate and create an environment in which collaboration for the development of more sustainable value propositions can take place. The 2nd life program in the RI plays a vital part in EVCo's solution business, as it is only possible because of the contractual agreement with the customer and the maintenance of the vehicles during the first lifecycle. The fleet management further is a prime example of how a traditional manufacturer expands its portfolio, in this case, through a software and IoT solution, with services to satisfy emerging needs.

This study uses the idea of stewardship, the way how companies manage the direct and indirect impacts of their decisions and activities within the wider systems they are part of, to evidence sustainability. Of the twelve resources, only culture as an operant resource as well as four operand (2nd life program, battery recycling, electric vehicle, fleet management), can be identified as practising stewardship. EVCo's culture, and in particular the owner's mindset towards sustainability, is a prerequisite for all activities to be more sustainable.

EVCo encourages all customers to return their vehicles after the first life and with some customers having takeback agreements, EVCo then recovers parts, properly recycles materials, and remanufactures the vehicles where possible to resell them as 2nd life vehicles. This reduces the leakage to the recycling of still useful parts and the requirement for newly produced parts. The 2nd Life activities lead to achieving both sustainability and profitability goals and by doing so evidence that solution businesses can have a beneficial outcome for both business and the environment.

1stMail, together with EVCo and other partners, ran a pilot for using the batteries of their used vehicles as static storage for photovoltaic energy produced on the roofs of distribution centres. Even though the batteries can be used in a first life in a delivery vehicle, a second life in a private vehicle, and a third life in a battery storage, after some

time the battery can no longer be used. Traditionally and currently, these batteries are shredded and thermally recovered but EVCo has in its own capacity developed a recycling process in which the material can be recovered purely and are not mixed. The battery recycling activities only lead to the achievement of environmental goals, and at the moment are only a cost factor. This indicates that EVCo is proactively practising stewardship and puts the achievement of all sustainability dimensions high on its agenda. Although the choice of the drivetrain initially was because of the technical advantages, the vehicles are inherently more sustainable as they do not rely on fossil fuels in the use phase and do not create local emissions. With fleet management, the company further offers a solution to reduce the energy consumption of the vehicles and by improving the driving style increases the longevity of the vehicles.

Although for the creation of value in the service ecosystem both operant and operand resources are required and are integrated, the findings suggest that because the stewardship practice takes place in the physical world, the operand resources are more important in a sustainable PL.

5.4.2 Evolving Value Propositions

EVCo's value propositions communicate the company's ability to facilitate the creation of superior ViU, which helps its customers achieve their goals. The analysis suggests that the solution provider not offers a single value proposition, but rather a combination of different benefits to the customer. Eleven of the 14 identified Value proposition components were mentioned frequently enough to be relevant for the means-end chain analysis. Outsourcing responsibility, reliability of vehicle, transparency and predictability of operating were not mentioned often enough. The study in different accounts suggests a tight relationship between EVCo and their customers in customising the integrated resources such as adapting the vehicles to environmental conditions or tailoring the fleet management system to the customers' operations. Although the integrated resources are tailored to each specific customer, the components which comprise EVCo's value propositions are the same for all customers. The respondents in most cases referred to the value proposition as benefits and used abstract non-quantifiable terms to describe, for

example, the purchasing decision which supports the idea of benefits from the Means-End Theory.

Three Value proposition components are responsible for about half of the mentions within the means-end chains, with the best tool for doing the job mentioned 26 times, and adaptability to market and extended resource lifetime each being mentioned 10 times. This high frequency of mentioning the best tool for doing the job makes this by far the most relevant value proposition component. However, it only supports achieving social value and economic goals and not true sustainable value. Interestingly, of the eleven value proposition components, only the emission-free electric drive leads to the achievement of all the goals. The majority of the Value proposition components, an entire six of the eleven elements (cheaper vehicles and spares, low entry barriers, durability of vehicle, communication tool, higher productivity, adaptable to market changes), lead to only achieving economic goals. This majority of only economic goals indicates that financial success is a main driver in the solution business. The driver feedback only contributes to social value and environmental value, and the improved vehicles and extended resource lifetime exclusively help in achieving environmental goals and not performance or social value.

The study found that two triggers for new value proposition design exist, - it can be a pull from the customer or a push from the solution provider. Entirely new products and services are predominantly driven by EVCo's market knowledge and developed internally and then pushed to the market, whereas companies that want to procure solutions based on existing equipment pull the development. Figure 5-9 depicts the development of the value proposition for the different customers over time. The figure shows how EVCo first developed an electric vehicle for senior citizens. Based on this model, a first base model for postal companies was delivered. This was then continually improved to develop the value propositions for the different postal companies. Whenever EVCo develops new features for their customers, they use them to improve and update their base model and implement these changes and options for other customers. This update is indicated by the curved arrows in the graph.

Customer goals change over time, and so customers periodically change what they seek in solutions. The study identified three significant changes in the customers which occurred over time: an increase in parcel delivery, uptime, and sustainability. The findings suggest that value proposition development is an ongoing iterative process, continuously improving the customer benefits and allowing to increase or change the ViU expected by the customers. Resources in the value proposition can be added, removed, or changed throughout a solutions contract to adapt to the customers' goals. New product development is initiated by EVCo and the market knowledge, whereas the customers' knowledge of using the resources is key to improving resources for existing and new value proposition.

Operant resources trigger value proposition development and improvement as well as value creation at different life cycle stages of the operand resources. This is in line with extant research that suggests that operant resources act on operand resources. Characteristically of solution business, EVCo's value proposition is developed for each customer individually by configuring the vehicles with unique features, customising the fleet management system, or tailoring the service plan to their needs. The data suggests that the value proposition development is not a linear process, but iterative and ongoing through the contract duration to improve the value for the customer. These improvements can, for example, be retrofitting existing equipment with newer technology, or the improvement of vehicles during the duration of rolling out an entire fleet over multiple years.

5.4.3 Customers Achieving Their Goals through Value-in-Use

The findings suggest that the three goal dimensions manifest in eight ViU constructs. More than half of the identified means-end chains lead to achieving profitability goals, with Lower Cost at 24 mentions being the most frequently mentioned ViU construct, followed by Growing Business (15 mentions) and Availability (14 mentions). The other half is equally shared by environmental value and social goals. The three ViU constructs for environmental value are equally distributed with Reduced resource leakage and waste at EoL mentioned 7 times and Reduced resource consumption in production and in use

each mentioned 5 times. Within the social value goal, safer vehicle use is mentioned 11 times and corporate citizenship 4 times, making this the least frequently mentioned ViU construct. The distribution of the means-end chains over the three goal dimensions depicts how the solution business is intended to be a profit-oriented model having around half of the mentions of the ViU constructs, while not neglecting the environmental and social dimensions of sustainable value.

The means-end chain analysis suggests that the ViU predominantly stems from the operand resources. However, the operant are necessary to produce those operand resources and configure them in a way that allows value creation.

5.4 Single-Case Study Findings

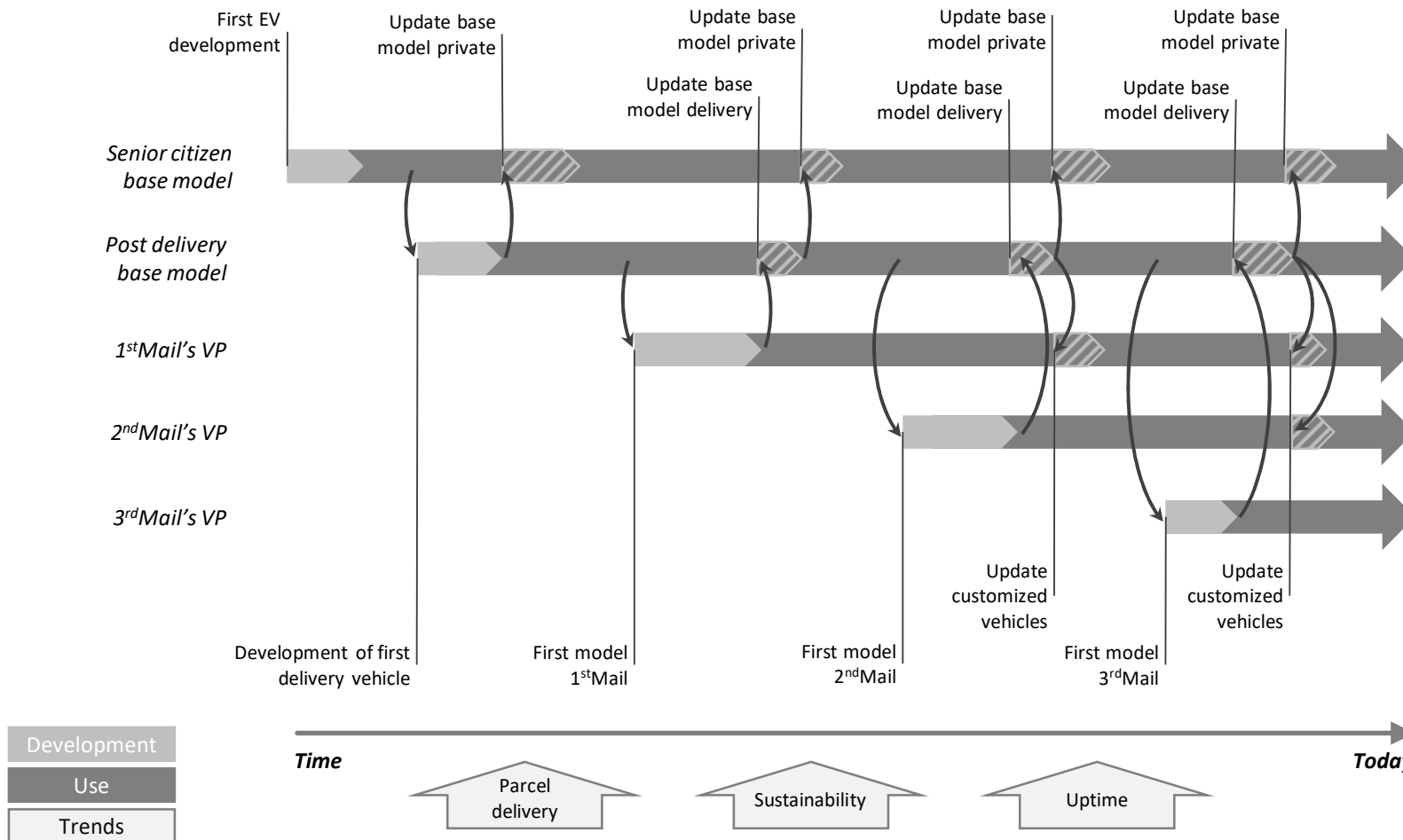


Figure 5-9: Evolving value propositions for EVCo's customers

The safety of employees and citizens stands above all, and profitability has always to be ensured before considering environmental sustainability. As public companies, the post companies have to be profitable and distribute dividends to their shareholders, and the respective governments. As state state-owned companies the customers are in a role model position, and both promote sustainable behaviour. Consumers and society as well expect them to behave sustainably.

The data suggests that goal setting and striving is a continuous dynamic process, in companies represented through strategy cycles. The priority on safety and the increasing importance of environmental sustainability leads to growing tensions for the actors in the service-ecosystem as previously maximising shareholder-value was the prime purpose of the firms. This hierarchy, however, was just recently established and is dynamic. For example, an informant from 3rdMail reported that safety has just become the top priority after some fatal accidents, and all three customers reported that environmental goals are a more recent development.

The case supports the idea that value is idiosyncratic to each actor in the service-ecosystem and has a temporal and spatial dimension (i.e. locus of value creation). As an example, 1stMail initially procured the vehicles because they were the technologically better option than the competition. However, the company developed a narrative around the delivery vehicles as a green alternative, and the perception is that they were procured because they are sustainable. There are different narratives for the purchasing decision is different in different departments of both supplier and customer. Representatives of the sustainability team within the customer claim that the vehicles were procured because they are more environmentally friendly than petrol scooters. In contrast, representatives from the operating department say it is because they are more efficient. The tensions caused by the increasing complexity lead to a challenging situation for EVCo and the procurement and fleet departments of the customers as they need to co-produce solutions that achieve multiple goals.

5.4.4 Enabling and Catalysing Factors

The case EVCo's service-ecosystem unveiled interesting internal and external factors that enable or catalyse the transformation towards more sustainable customer solutions. These are presented in Table 5-8.

Internal enablers

Internal enablers are required to engage in stewardship activities. Financial independence is a major financial reason for the sustainable engagement of the company. Because the company is fully family-owned, the CEO has the independence to aim for business goals other than just shareholder value, and can invest the funds available for sustainable solutions and innovation as opposed to paying it out as dividends or compensations. The proximity within the company, both physically and in communication, is a key enabler to design for repair, and service, because everyone in the organisation is very close together and the hierarchy is flat. The flat rate maintenance contracts EVCo. offers are a main source of circularity because the company has to keep the vehicles safe on the road but there is no requirement to use new parts. Flat fee maintenance contracts make it justifiable to reuse reconditioned parts over new ones. Due to the long contract duration, it was and is somewhat predictable when how many vehicles will return. In-person audits of the main suppliers are a way to ensure that suppliers comply with agreed conditions, norms, and the customers' codes of conduct.

Internal Catalysts

In addition to enablers that are vital, catalysts accelerate the transformation towards more sustainable CS. EVCo's ISO14001 certification is one of the measures of how the company proves their sustainability. EVCo has as well-developed internal standards such as identifying materials that should not be used. The ISO certification helps to raise the awareness for sustainability within the organisation and acts as an amplifier and role model function as they require service partners to behave in a certain way, such as disposing of waste professionally. Sustainability thinking is not actively promoted in the company, but it is a very intimate environment, and proactive sustainability thinking is encouraged.

According to the CEO, it is important to have people that have an ecological consciousness, as people who have this interest are more intrinsically driven and require less supervision. Oftentimes people applying who want to join the company do so because the products are relatively sustainable. However, it is more important that they fit into the team and are not starry-eyed idealists and eco-fundamentalist, as those are too narrow-minded and things can be improved, but at the end of the day, the product has to leave the factory. If people only focus on environmentalism and ecology, you find a hair in every soup.

Stewardship is actively practised and promoted in the second life operations, and the company invites all customers, private and business, to get their vehicles professionally disposed of or remanufactured, not only for the ones that are on a buy-back contract. Technological advancements, such as predictive maintenance, are ideas EVCo is working on, and the data is available, but it has not fully been implemented but used when regular maintenance cycles take place to know what needs to be replaced. For the future, the company is developing new self-driving solutions for logistics in car-free cities where they work on pallet transportation and self-driving solutions to bridge the gap between the semi-truck and the last mile delivery. Getting started with remanufacturing operations in the 2nd life project unveiled issues as well that involved suppliers. For example, the chassis is one of the parts that is often damaged has been changed by the supplier, or design issues such as connection that cannot easily be separated in the dismantling process, such as the press-fitted wheel hub.

External enablers

In EVCo's case, stewardship is externally enabled and driven a lot by policy. The products must undergo a compliance process, such as minimum durability, and ensure that hazardous substances are taken care of professionally. These kinds of regulations create entry barriers for environmentally damaging companies and create ecosystems that have to follow certain rules and standards. Because many post companies are fully or partly state-owned, the government is an actor in the ecosystem as well and procurement falls under the WTO regulations for public open tenders. The base parameter is that it is

advertised for bids open for electric vehicles, so the environmental compatibility is already prescribed. Sustainability is an important procurement criterion, in particular for larger customers, and sometimes even a requirement.

Sustainability-related issues and certifications are oftentimes a hygiene factor. In tenders within public procurement, it is mostly the case that there has to be some proof that there are environmentally friendly processes in place, and ISO 14001 helps to prove that. ISO certifications make it easier in a tender process to prove that the company is behaving sustainably. EVCo themselves deem environmentally friendly practices as important and require that from suppliers and partners and as well audits them. In this case, sustainability-related issues triple down the supply chains when solutions are purchased by public procurement.

Table 5-8: Enablers and catalysts

	Enabler	Catalyst
Internal	<ul style="list-style-type: none"> • Financial independence • Proximity within the organisation • Flat rate maintenance contracts • Predictability of vehicle returns from customers • Supplier audits 	<ul style="list-style-type: none"> • ISO Certification and a role model function as a company as an amplifier in the service-ecosystem • Employees that are interested in sustainability are intrinsically driven to work for the company and need less supervision • Take back scheme for all vehicles from all customers • Technology and processes for predictive maintenance and reduction of pollution • Start practising stewardship at some point to start learning and becoming better at it
External	<ul style="list-style-type: none"> • Legislation supporting sustainability • WTO tenders allow smaller companies to bid • Sustainability becomes a hygiene factor/order qualifier • Certification helps to evidence sustainability in the tendering process 	<ul style="list-style-type: none"> • Increased exchange with suppliers helps to solve problems quicker • The innovation of processes is made publicly available to increase the impact on the company's concerns • Products are widely used in public that conveys a message that sustainability is possible • The demands of one customer can increase the sustainability of an entire service ecosystem • Differing needs in different markets are a driver for the business case for remanufacturing

External Catalysts

Increased exchange and involvement with suppliers over the last years and direct access to their know-how have served as a major external catalyst for business success and to influence EVCo's design and production. In cases where intensified co-development was

not possible, such as the recycling of batteries. EVCo took an initiative. Under the CEOs guidance, the company is developing a recycling process for their batteries, not to recycle the batteries themselves but to make a case that it is possible and feasible to do so. This process will be made freely available. Initially, 1stMail has procured the EVs because they were the better solutions. However, the customers role in using the vehicles in public over the years as a sustainable alternative, to not pollute the environment with fumes and noise, is now used as part of the branding and EVCo is using them extensively in marketing for their green image.

In a project, 1stMail ran tests for reusing batteries as static storage for photovoltaic. Not because they had to take care of the batteries, but because they wanted to make a case that the products they buy, and use, have an afterlife and are not disposed of. These examples show how the products are used and leveraged to both better 1stMail's image but as well make a case that sustainable alternatives exist. In the process of selling products to existing and new customers, customers want to see concrete examples. For instance, what have you changed in the past three years, or what parameters have become better over the last years. EVCo has to continuously improve towards more sustainability and as well expects from the service partners and suppliers that they follow more sustainable practice. For example, having professional waste disposal processes in place, paying above minimum wage and not employing child labour. In this way the sustainability performance of the entire network increases. Having the possibility to deliver second-life products to other countries, such as eastern Europe where the expectations to newness are less high and they are interested in getting used vehicles for a lower price, increased the business case for remanufacturing.

5.5 Developing Sustainable Customer Solutions: Answering RQ2

This single-case study presented was conducted to answer the second research question developed in Section 1.3 asking: *How is value in sustainable customer solutions created?* To answer this question, the study used means-end chain analysis (Vriens and

Ter Hofstede, 2000) to identify how the integrated resources lead to benefits for the customer and the focal manufacturer (Edvardsson et al., 2011) in order to help them achieving their goals (Findsrud et al., 2018). These means-end chains developed in Section 5.3 build the foundation to answer this sub research question.

The study found that value propositions are a combination of benefits derived from resources that are continually added, removed, or changed throughout a solution's contract to adapt to the customers' goals and form the link between RI and value creation. To create those benefits, a mix of operand and operant resources are integrated. The findings show that operand and operant resources are equally important, and that the operant work on the operand resources with the operand resources being the carrier of the potential value in the physical world.

Means-end chains are found to be a valuable tool to investigate how RI at the micro-level leads to the achievement of goals at the macro-level. In particular, means-end chains allow us to evidence how stewardship practice in the RI leads to the achievement of multiple ViU constructs. In the case presented, the majority of the means-end chains lead to the achievement of economic goals. They do however as well contribute to achieving environmental and social value, and therefore create sustainable value.

Value propositions are created either as a result of a development by the supplier that is pushed to the market, or a request from the customer that is demanded leading to a development pull. The study strongly suggests that the goals of a customer are dynamic and continuously changing, and that these changes, such as incorporating sustainable development in goal setting, leads to tension that influences the ViU creation a customer is seeking. Once an initial solution is developed, the customer and solution provider continuously improve the solution in a dynamic cycle of RI and the assessment of ViU criteria. This improvement is initiated by recognising the change in goals which require new benefits and the provider changes the resources that are integrated, leading to a top-down improvement of value proposition in respect to the means-end chains.

6 DISCUSSION

This Chapter discusses the findings of the two studies in Chapters 4 and 5. Section 6.1 discusses the findings of the multiple-case study which was set out to investigate the conditions under which customer solutions (CS) are sustainable and discusses the instances of complementing and competing logics. Section 6.2 discusses the finding of the single-case study that was conducted to find out how value in sustainable CS is created. The findings from the two studies are discussed from an institutional perspective in Section 6.3, followed by the discussion of barriers derived from the multiple-case study and drivers from the single-case study in Sections 6.4 and 6.5 respectively. Section 6.6 synthesises the overall findings of the study and presents a framework for sustainable RI practices in CS.

6.1 Business Logics in Sustainable Customer Solutions

The process of servitization has been described conceptually and investigated empirically over the past two decades within and across different research communities (Brax and Visintin, 2017; Rabetino et al., 2018). Extant research has initially investigated the phenomenon from both a business side, with the aim to create more customer value, as well as from an engineering side, with the aim to reduce resource consumption and an environmental side – the two streams however increasingly mix. Previous studies on the topic of market logic (ML) and production logic (PL) usually discuss the sustainable PL and the service ML as a desirable end-state and therefore do not describe traditional PL and the product ML.

This research used ideal types to describe these four logics in the discussion. Multiple present logics can be compatible and support each other (Besharov and Smith, 2014; Smith and Tracey, 2016), but cases where logics are conflicting and inherently incompatible or competing and a dominant logic must be prioritised by the actors are managerially more challenging (Greenwood et al., 2011). This section describes the activities for service ML and how they relate to sustainable PL.

The research presented uses the idea of value-in-use (VIU) which is co-created, with the customer as an active participant and contributor to value creation during the use of the offering. The manufacturers, through resource integration (RI), provide a set of service elements to create this ViU. The findings are in line with Yang and Evans (2019) who found that manufacturers not only have a single CS in place, but co-existence of different CS at the same time. The different configurations of products are in the literature described as archetypes of solution business reaching from product- to use- to result-oriented (Bocken et al., 2014; Tukker, 2004).

The findings corroborate that servitized products are supported by the supply chain network throughout their (multiple) life cycle stages (Brax and Visintin, 2017; Yang et al., 2017). These stages consist of beginning of life (BoL; including the concept, design, plan, source, manufacturing, delivery, and installation phase), mid of life (MoL; the use phase with monitoring and maintenance) and the end of life (EoL; including the collection, recovery strategy, redistribution, disposal phase or the introduction into a secondary market).

6.1.1 Stewardship Practice

The use of stewardship practice has been proven useful. Similar approaches have been investigated under the research around sustainable manufacturing. However, this research uses a more holistic approach than just the technical aspects of manufacturing. De Burgos-Jiménez et al. (2013) suggest that in the context of the natural environment, strategies have primarily been placed within a continuum that varies in the way organisations deal with the protection of the environment relative to what is required. The findings of the presented study concur with De Burgos-Jiménez et al. (2013) in that the stewardship practice lies within this continuum in which “proactive” is situated in opposition to “reactive”.

Proactive postures demonstrate a voluntary adoption and development of practices that go beyond obeying the law with respect to taking environmental issues into account. EVCo, for example, developed a recycling process for EoL batteries. A reactive posture,

whether deliberate or unintentional, merely meets the minimum standards in respect of the environment and compliance with regulation. Whether the manufacturers were proactively practising stewardship was oftentimes difficult for the respondents to identify, as they themselves were not sure what stewardship practice for them means. The challenge of proving if and when a more sustainable CS is offered was as well observed by Hallstedt et al. (2020). The respondents in the Hallstedt et al. (2020) study mentioned that it could be an improvement in one of the life cycle phases that meant a more sustainable CS or it has to be supported somehow, - for example, by using defined sustainability criteria, or from measuring sustainability indicators.

The study presented did not aim to measure the sustainability or circularity of the entire case companies, but to identify and characterise specific, proactive practices. Growth is independent of finite stocks of resources, eliminates waste, reduces the flow of material through the economic system and virgin-material consumption, based on CE principles to preserve resources (Murray et al., 2017). These identified practices could be identified throughout the different lifecycles of the CS and can be broadly differentiated by technical and cultural driven practices and relate to the CE principles identified in the literature review in Section 2.3.3.

Practice in BoL

The study conducted shows different level of customisation, which describes how much the products and services are adapted to individual customers' needs (Reim et al., 2013). The results are in line with previous research (Azarenko et al., 2009) which suggests that if the number of customers is quite high, such as in product oriented services, the customisation is limited, whereas result oriented business models will always require a higher degree of customisation, because the service is integrated with the customer's operations.

The product and service design must be adapted to customers' special needs through co-development with customers and supplier. This leaves room for innovations that would benefit not only the provider and the customer but even society in general (Reim et al., 2013; Tukker, 2004). The findings of the presented research confirm previous research

(Hallstedt et al., 2020) that engineering and manufacturing capabilities need to be developed or found within partners for the provision of CS. A main capability required for the development of more sustainable solutions is the consideration of resource efficiency and making sure that waste throughout the CS lifecycle is designed out. Reducing waste in the design phase could be identified in all three cases so some degree and a cornerstone of practising stewardship, suggested by academia (Bocken et al., 2016; Ghisellini et al., 2016; Rashid et al., 2013), practitioners (BSI, 2017; Ellen MacArthur Foundation, 2015a; McDonough and Braungart, 2010), and governments (European Environment Agency EEA, 2016).

Respondents from all companies reported on the importance of, and challenges related to, the use of pure and nontoxic materials. Keeping materials pure by design (Bocken et al., 2016; Ellen MacArthur Foundation, 2015a) is an important factor during development to ensure that components can be appropriately recovered and recycled at the end of CS lifetime. EVCo, for example, excelled in this by designing their vehicles in a way that all the components can be disassembled into parts containing only one material. CableCo, on the other side, reported that companies are increasingly asking for complex parts that are moulded and combine multiple casted components. In all three cases, the respondents reported that they increasingly co-develop their CS with customers and suppliers which indicates systemic thinking (BSI, 2017; Ellen MacArthur Foundation, 2015b). This is in particular important to ensure that the true cost of products are transparent throughout the entire supply chain, with all suppliers being responsible for their own stewardship practice.

Practice in MoL

The findings of the study presented multiple service-logic practices in the use phase of the CS, in particular around services and monitoring. Optimised operations and maintenance describes various mechanisms and approaches to use products and services more efficiently in their application context, for example, to reduce failure rates or streamline processes (Blüher et al., 2020). In the case of PumpCo and EVCo the assets' health are monitored through IoT based CS, which according to Blüher et al. (2020) is a

driver for sustainability. Through the maintenance, repair and overhaul of the assets used, the operators extend the product lifetime to reduce costs for replacement, which leads to both economic and environmental benefits (Blüher et al., 2020). The literature refers to these practices as activities that ‘keep value high for as long as possible’ (BSI, 2017; Ellen MacArthur Foundation, 2015a; Kirchherr et al., 2017). Through monitoring and repair and maintenance which result in a life extension of the involved assets, the material throughput through the economic system can be reduced by what Bocken et al. (2016) call slowing resource flows.

Practice in EoL

Business models with closed material loops cover all aspects of the capabilities of solution businesses to control products to their EoL (Blüher et al., 2020). In the presented study, appropriate EoL scenarios could be observed in the case of EVCo and PumpCo, both of which remanufacture the assets in their CS for a second life or change in use requirements. Both companies try to use recycling as a last resort and aim to follow the hierarchical 3R principles (Ellen MacArthur Foundation, 2015a; Kirchherr et al., 2017). EVCo, in particular, is keen on ensuring that biological and technological materials are ‘food’ and not ‘waste’ and re-enter the biosphere or supply chain, an important cornerstone identified previously in the literature (Andersen, 2007; Scheel, 2016) and exemplified through the development of the battery recycling plant.

In the case of CableCo, the reuse of the cable reels is supported by the research by Kaddoura et al. (2019) found in their study of solution business alternatives to passive products that in none of the products the return transports, repair/refurbish activities, such as repainting, or the travel of maintenance personnel, outweigh the environmental benefits of the circular offerings. The products in the researchers' study are similar in complexity. Therefore it can be assumed that the environmental benefits of collecting and reusing the cable reels outweigh the emissions related to collecting them.

6.1.2 Requirements for Sustainable Customer Solutions

Stewardship practices that are compatible with the manufacturers' servitization efforts and eventually lead to more sustainable CS could be observed in all three cases. Interestingly, the environmental benefits of the RI practice in some instances are unintended spillover effects of economically driven activities, whereas in other instances these practices are intentionally incorporating stewardship and therefore are inherently sustainable. Previous research (Guldmann and Huulgaard, 2020), found that more sustainable business models are only relevant to some customers and product types and that customer benefits and acceptance of such are uncertain. Linder and Williander (2017), for example, suggest that only certain types of customers are suitable for remanufactured products. These types include customers who need to retain a specific product for their processes or want to avoid reapproving a product, such as in the case of the retrofit of PumpCo's CS, or customers that are price sensitive and want to extend the life of a used product, or are environmentally interested, as with the case of EVCo's vehicles.

6.1.2.1 Environmentally Beneficial Spillover

The presented research found that in all three cases, the beneficial spillover effects were initially unintended, and the practice was established for economic and strategic purposes. The CS in the inquiry proved to be a more sustainable alternative in comparison with traditional product sales. The unintentional environmental benefits concur with current literature which has the understanding that sustainability is not an intrinsic characteristic of solution businesses (de Jesus Pacheco et al., 2019), and several recent studies have discussed that the environmental performance of solution businesses can indeed, in some cases, be worse if compared to traditional approaches. Schenkel (2015), in fact argues that environmental and social values created by closed-loop supply chain activities are almost exclusively the by-product of economic or customer value and Matschewsky (2019) posed the question whether there is such a thing as unintended circularity and concluded that companies, focused on their own best interest, stumble upon solutions that benefit all when becoming providers of CS. The researcher concludes that the better

industry actors who understand the benefits of being highly efficient and lifecycle-focused, the more they can comply unintentionally with what academics understand to be characteristics of stewardship practice. The presented research agrees with that conclusion in that it found that the more advanced the CS, the higher the potential for increased stewardship.

According to Matschewsky (2019), path dependency, inertia, and lack of knowledge will likely continue to hold many industrial actors back on the traditional path if they do not ‘walk’ the stewardship path consciously. Environmental benefits can occur through servitization, however an additional challenge identified by Kaddoura et al. (2019). The environmental and financial benefits of added services are oftentimes not proportional. The researchers found in their study of service-based alternatives to passive products that the cost reduction was less pronounced than the reduction of the environmental impact, an issue that is likely to be the case in all three investigated cases and in particular in the case of CableCo. In most cases, the addition of services to prolong the lifetime of products is expected to incur higher labour costs caused by collecting, recovering, and redistributing product, which at best makes a stewardship practice such as reusing cable reels in the case of CableCo cost neutral. It does however lead to significant environmental benefits.

The main beneficial spillover effects in the CS occur during the use phase and at the EoL of the assets in the companies’ CS. In the conducted study, the cases of EVCo with their fleet management system and in the case of PumpCo with the asset monitoring system, support the findings of Hallstedt et al. (2020) who found that sustainability advantages can be achieved by tracking real-time data during usage phases to avoid extra repairs or to optimise the maintenance. In both the presented research as well as in the study conducted by Hallstedt et al. (2020), the more resource-efficient and sustainable service-oriented and digitalised solutions were not, however, developed to purposely develop more sustainable CS, but were driven by customer needs and profitability. The cases of EVCo and PumpCo further evidenced that servitization leads to improved energy consumption and therefore enhances environmental performance, an effect previously observed by Doni et al. (2019). The researchers found, however, that servitization did not

affect corporate sustainability disclosure and other environmental policies such as environmental assurance, emissions reduction policies, and environmental supply chain management. A similar study found that sustainable EoL management does not have a positive, significant relationship with environmental and social performance. This implies that the main purpose of companies implementing sustainable EoL management is not to gain environmental and social benefits. The presented study supports the findings of Doni et al. (2019) and Abdul-Rashid et al. (2017) in that the CS was not developed to increase environmental performance, nor are monitored for their beneficial impact.

6.1.2.2 Deliberately Developing Sustainable CS

The findings of the conducted study suggest that only one of the three cases, EVCo, intentionally practises stewardship and is therefore truly sustainable. Different factors need to be present as prerequisites for sustainable solutions and the research presented found that means and end must align for a result that is truly sustainable. This is a finding that could not be identified in literature so far, although researchers used ‘win-win’ (Doni et al., 2019) and ‘synergies’ (de Burgos-Jiménez et al., 2013) to describe how servitization leads to both economic and environmental benefits.

Manufacturing companies play a big part in a product’s life cycle. They exert great influence on both the user and the product’s final destiny (at EoL) through product development and design which makes it, according to Bjørnbet et al. (2021), even more important to take a holistic approach to research on stewardship practice in the manufacturing sector. Marić and Opazo-Basáez (2019) found that voluntary pro-environmentalist attitudes toward product returns, rather than solely commercial gains or legislation-imposed pressures, facilitate closed-loop supply chains model development. This is a finding that this research strongly supports, given that the founder and owner of EVCo has a strong interest in developing and selling environmentally sustainable CS.

A key principle for a more circular economy is that the companies are financially viable and maintain economic growth (Kirchherr et al., 2017; Murray et al., 2017; Upward and Jones, 2016), a factor that EVCo’s management emphasised. Successfully implemented business models can signal a proactive approach (Reim et al., 2015), that will ensure

sustainability-driven changes meet the dual goals of economic and environmental benefits. Deliberately developed CS that give a company a business advantage and at the same time contribute to a more sustainable society through service connected to the product (Hallstedt et al., 2020) are possible. This is demonstrated by the case of EVCo.

Matschewsky (2019) argues that if the goal is to achieve absolute resource decoupling, it is likely that only result-oriented offerings can achieve that goal, as they ensure full provider flexibility in how customer value is created. A similar claim is made by other researchers such as Yang and Evans (2019) who found that the more a solution business involves manufacturers owning products, the greater the potential for creating sustainable value, or Szász and Seer (2018), who found that only advanced services can contribute to a higher sustainability performance.

Adopting a customer-oriented solution business motivates manufacturers to be more resource-efficient and responsible in manufacturing the product and managing its use, reuse and disposal throughout the whole lifecycle. The findings of this study indicate similar results and suggest that the more advanced the CS are, the higher the sustainability potential. However, even in the case of EVCo, which according to the findings is the most sustainable, the company does not offer fully advanced services and therefore the study cannot assume if, for example, a pay-per-mile business model based on the outcome would increase the stewardship practice. Still, the study agrees with Matschewsky (2019) who argues that efficiency improvements are always sought, but a move towards making stewardship practice a central goal would likely require a comprehensive change in the overall resource strategy and revenue model.

Manufacturing companies that are undergoing servitization will likely depart from their history and prior knowledge (Matschewsky, 2019) and a move towards increased stewardship practice must be linked with the fulfilment of a certain customer need and how this can be achieved most efficiently. An advance for EVCo is that most of the customers see themselves as role models for sustainability and demand it from the suppliers as well. This applies in particular as Post companies are national symbols with strong sustainability agendas. For example, EVCo's largest customer developed an

energy storage system with used batteries to showcase that they care about the EoL of their vehicles. From this standpoint, the case paints a picture of a shared ideology between customer and supplier which reduced the internal resistance and increases the acceptance within both companies. The ideal for a sustainable CS, arguably, is what Hallstedt et al. (2020) observed that both companies had as a main priority to be updated on keeping sustainability on a level where the technical and legislation requirements are met, and customers are satisfied, as they are the main driver for sustainability.

6.1.3 Trade-offs in Customer Solutions

The findings of the study show that the service ML of manufacturers providing CS in some cases is competing with the sustainable PL and require them to choose between different practices. These trade-offs represent specific situations in which to act means choosing either one path or the other and partially ignoring the other in decision-making (Wannags and Gold, 2020). In these situations, it is usually impossible to achieve all practices at once, and sacrificing one to obtain the benefits of the other is unavoidable (Haffar and Searcy, 2017).

Haffar and Searcy (2017) found that commercial goals and sustainability goals frequently conflict with each other, a trade-off observed in all three cases in this study. However, eliminating either one of the poles is inadvisable. To abandon profitability, the core purpose of corporations, or to abandon sustainability because of planetary boundaries (Wannags and Gold, 2020) isn't feasible. Hahn et al. (2015) propose that tensions in pursuing multiple logics are typically at an individual and/or organisational level, when they occur because of personal versus organisational sustainability agenda or the pursuit of corporate short-term versus corporate long-term orientation. Also, they occur at organisational and/or systemic level such, as isomorphism versus structural and technological change and efficiency versus resilience considerations. As described in the following section, the tensions in the observed cases are predominantly at the individual and organisational level.

The trade-offs can be described by what Ocasio (1997) calls the ‘attention allocation problem’ that argues that attention is a limited resource and that decision-makers need to concentrate their energy, effort and mindfulness on a limited number of issues to achieve superior performance. Ardito (2021) found that pursuing dual strategies can be negative for innovation performance, due to the limitations in resources available. The reasons for this effect can be ascribed to the complexity of managing the different types of resources underlying servitization and environmental orientations, as well as in committing such resources to unrelated goals. Other researchers found that trade-offs must be made when pursuing production and market share expansion (Shahbazi et al., 2016), and that sustainable production is incompatible with existing traditional operations (Tura et al., 2019a). The main trade-offs observed in the presented research are inferior economic performance and increased operational risk that would be required to increase stewardship practice.

6.1.3.1 Economic Performance or Stewardship Practice

Issues related to financial aspects are in the literature mostly described as barriers. However, the respondents in this research predominantly said sustainability would be possible, but margins are not as good. An explanation is given by De Burgos-Jiménez et al. (2013) argue that when comparing environmental and financial performance, the short-term financial benefit tends to show that there is a negative correlation and long term is positive. The researchers argue that there is probably a time lag between environmental performance and the occurrence of positive effects on financial performance, further suggesting that positive relations should occur in the medium and long term.

The findings of this study suggest, based on the respondents’ from EVCo, that remanufacturing is currently riskier and with lower margins than new product sales. The ideology of “Not always seeking the most profitable but the most sustainable” must be lived and EVCo is seeing itself as a sustainable company with the intrinsic motivation to be more sustainable because it’s the right thing to do. The findings of this study concur with previous research, such as Abdul-Rashid et al. (2017), who found that sustainable

product design and development has a positive impact on environmental performance, but it does not have a positive impact on economic and social performance. This implies that sustainable product design and development does not have a direct, immediate impact on economic performance. The research conducted further agrees with Matschewsky (2019), who identified a central challenge of an economically-driven transition to and limitation of sustainable solutions: Providing more product components to customers continues to be economically advantageous for most companies. Even if fewer components might be sufficient “to get the job done”, manufacturers expand their production because producing and placing more physical components on the market constitutes the basis of many companies’ operations and workforce.

Financial challenges in the cases of PumpCo and CableCo were identified. Both of the companies stated that it would be possible to increase stewardship in the CS, but that customers would not be willing to pay for it. Lee and Hageman (2018) argue companies typically place greater weight on financial outcomes than non-financial outcomes and that adoption of environmental sustainability policies often leads to short-term decreases in profit, even though in the long-term profit may increase. The findings with the case of CableCo and the price of collecting reusable cable reels further support the findings of Veleva and Bodkin (2018), who in their research identified that cost of providing a take-back service for plastic packaging and the related logistical and technical issues often make collection economically unviable.

Increasing the stewardship practice in CS may not only be less profitable but as well riskier than traditional ways of production. Linder and Williander (2017) argue that sustainable business models are always a higher risk than validating a corresponding traditional business model. The reason is that such validation cannot be achieved without a second (or third etc.) sale, and this second cycle requires resources exposed to risk. Although EVCo has contractual take-back agreements in place and in theory long planning cycles, they don’t exactly know when, how many, and in which condition vehicles will return, which makes planning remanufacturing operations difficult, as some vehicles can be fully remanufactured, and some are ‘driven to death’. From this

premise, increasing the servitization efforts would be counterintuitive and pose an internal economic barrier.

Previous research has investigated the uncertainty of servitization on environmental benefits, finding that some studies have shown that an increase in service intensity may benefit companies in terms of growth of sales and profitability, while others have reported the opposite (Doni et al., 2019). Zhang (2021) reports in their results that servitization is positively related to the social performance of manufacturing firms, but its impact on environmental performance is insignificant. While Reim et al. (2015) state that solution businesses in some cases can even have a negative effect on the environment, while maintaining only economic benefits. The case of PumpCo and the use of additive manufacturing in their servitization supports these previous studies, as the long-term environmental benefits are unclear and may even be negative.

The findings of this study support previous research that identified trade-offs for increasing stewardship practice (Guldmann and Huulgaard, 2020; Heyes et al., 2018; Paletta et al., 2019; Shahbazi et al., 2016), and confirm that the increased financial and operational risk for moving from traditional to sustainable PL holds only little evidence of financial and environmental benefits. The findings of the two cases of EVCo and PumpCo further suggest that increasing the servitization efforts would not necessarily increase stewardship practice.

Matschewsky (2019), in line with this finding, suggests that a unit sold to an end customer through product sales would very likely also receive maintenance and be sold on to additional customers in the case that the initial customer no longer needs it. The literature usually points to the unique knowledge the provider has about the offering, with the ability to adjust the design to facilitate maintenance and longevity, and the ability to upgrade units already deployed when clarifying efficiency gains related to maintenance. However, in many cases, such as the PumpCo example, the customer now has the asset in daily use and knows the equipment thoroughly, and may be as knowledgeable about these gains as the manufacturer of the equipment.

6.2 Sustainable Value Creation in Customer Solutions

A tenet for sustainable value propositions is that companies act proactively to reduce the consumption of finite resources, pollution, and waste (Geissdoerfer et al., 2017), while achieving profitability and social value. In particular, discussions in the field of CE, which focus on the decoupling of economic growth from resource consumption, researchers argue that sustainability cannot be evaluated through the lens of environmental impacts alone (Kaddoura et al., 2019). The three nested dimensions of economic, environmental, and social dimensions are interdependent. This means that the solution provider company cannot be sustainable if the social system and/or the ecological system is not sustainable. It was evident, however, from the interviews that some companies consider the ecological dimension as being separated from the social dimension (Hart and Milstein, 2003). If through the entire life cycle, not all, but only one of the three sustainability dimensions is considered, local optimisation of one dimension can lead to suboptimisation of the entire system. As pointed out by Hallstedt et al. (2020), this is, in particular the case if a common sustainable vision of a future solution is lacking.

Decision makers must be able to see the financial implications of making such a transition from a traditional to a sustainable PL, in particular under in light of the fact that many of the stewardship practices involve additional labour cost, a concern identified by (Kaddoura et al., 2019) and confirmed with the presented study.

Previous conceptual (Matschewsky, 2019) and empirical (Szász and Seer, 2018) research argues that if the focus lies on absolute resource decoupling and a goal of servitization is to increase the sustainability performance, the company would likely be more successful if the service is more advanced, both to increase the sustainability (Tukker, 2004) and the competitive advantage (Gebauer et al., 2005; Oliva and Kallenberg, 2003). In the presented study, the respondents unanimously reported that they don't think that increasing the service component, in particular to an outcome-based model, would lead to more resource-efficient and responsible manufacturing. The findings of this study confirm previous conceptual and empirical research which argues that increasing service increases sustainability (Tukker, 2015, 2004; Yang and Evans, 2019). However, this

research does not confirm the claim that the more a manufacturer servitizes, the more sustainable they become. The presented study more so suggests that each company is unique and that the sustainability potential of servitization varies from case to case.

Previous research has argued what sustainable value is (Bocken et al., 2013; Evans et al., 2017; Hart and Milstein, 2003) and empirical research such as Yang and Evans (2019), has identified different benefits that derive from product-service systems. The review of the literature, however, found that there is a lack of research investigating how the integration of operand and operant resources leads to sustainable value. The central tenet of a means-end approach is that customers are goal-directed and acquire and use products or services to minimise undesired consequences and to accomplish favourable ends (Khalifa, 2004; Sánchez-Fernández and Iniesta-Bonillo, 2007). Established marketing research (Zeithaml, 1988) postulates a hierarchical linkage between attributes of products and services, and values and behaviours preferred or sought by customers.

Benefits to customers are the consequences which are created by the use or consumption of these attributes. Values, benefits, and attributes form a chain of hierarchically-related elements and underlie their decision-making processes of customers (Botschen et al., 1997) with value being at the highest level of abstraction (Zeithaml, 1988). The conducted research supports the idea of a hierarchical chain of abstraction, and in particular highlights that the integration of resources leads to the creation of multiple benefits. This in turn leads to the creation of multiple ViU constructs.

The study identified resources with different roles at different times that are required for the creation of value in the service ecosystem examined. In this case, the operand resources are core to value realisation for the customer in the use phase, in which real value is created (Grönroos and Voima, 2013). Although operant resources are core to the value proposition, development tasks and research suggests that operant resources are more relevant to value realisation. Stewardship takes place in the material world and reducing physical waste, resource consumption, and pollution. This is what leads to achieving sustainability goals. The relevance of resources is evidenced in the means-end chain analysis which shows proportionally more operand resources in achieving

sustainability goals. The identification of the resource-integration practice of EVCo is described in-depth in the Section. 6.1

6.2.1 Evolving Value Propositions

Existing research has produced different patterns, frameworks, and archetypes for sustainable solution business. However, most of them assume that the development is a planned, conscious process with different iterations. The study is in line with previous research (Ballantyne et al., 2011; Payne et al., 2017), which suggests that the value proposition reflects the firm's core strategy and is used to communicate EVCo's promise on how it will deliver its offering to serve their customers. The research presented supports the study by Payne et al. (2020) in that the development of value propositions is not a linear process, but paints a picture of solution development that is much more 'organic', iterative, and constantly changing.

The iterative cycle of value proposition development can be in particular helpful for sustainable CS as it is in favour of the manufacturer with a willingness to develop sustainable CS proactive instead of being reactive. In the work of Hallstedt et al. (2020), similar to the study presented, medium-sized companies were investigated where the researchers found that with stepwise improvements of the product life cycle, driven by either customer requirements, future customer goals, or own ambitions, more sustainable CS were developed.

The study further identified two triggers for new value proposition design - customer pull and supplier push. This confirms that, potentially, valuable propositions can be crafted by any initiator and become a start for participating with other actors, a proposition previously suggested by Ballantyne et al. (2011). The iterative cycles help the solution provider gain a deep understanding of the end-user which, as suggested by Baldassarre et al. (2017), can be used for the development of sustainable value propositions and steering towards directions that are more desirable for the users themselves and that can influence their behaviours in a virtuous manner. In the case presented, the understanding of the

customer occurs in particularly in the monitoring of the use cycles and driving styles of the vehicles, hence supporting Baldassarre et al. (2017) suggestion.

The presented case of EVCo supports the findings on customer-driven innovation by Visnjic *et al.* (2017), who suggest that in regular new product development the innovation stops at the product launch, whereas in more service-oriented CS, the innovation starts with signing the contract and opportunities for value creation emerge during the operation of the product-service activity as the provider generates knowledge about the customer and its operations. The feedback loops for the continuous solution development are informed by direct customer feedback and reclamations as well as the intermediaries (Hakanen et al., 2017). In the instance of EVCo the service partners, as suggested by Raja et al. (2013), work closely with customers to co-define the type of service needed and need to develop a deep understanding of their customers' businesses to focus on the attributes that will lead to ViU.

Using means-end chains in the investigation on value in CS supports the idea by Tukker (2004) and Reim et al. (2015) that the provider promises a result on an abstract level which allows a high level of freedom and customisation for the provider, with carefully chosen performance indicators. These agreed-upon performance indicators within the solution contracts align the provider's preferences with the customer's preferences to maximise performance effectiveness in the CS (Hypko et al., 2010). The presented study suggests that the contracts in the CS act as the formalisation and link between the value proposition and the ViU construct, defining how the elements of the CS lead to value and what they are measured against. Hypko et al. (2010) argued that by aligning the provider's preferences long-term with the customer's short-term preferences to maximise performance effectiveness and efficiency, the solution provider is more likely to improve customer loyalty by selling performance-based contracting than by conventionally selling and supporting machinery or equipment. The presented study supports this finding, although the study does not suggest that the more the solution provider servitizes, the higher the loyalty.

As suggested by Saarijärvi et al. (2014), making use-data available to the customer and not only using it for their own development purposes allows EVCo's customers to create value for themselves that would not be possible through the provision of goods only. Through the reverse use of customer data, the company can help customers to become more responsible drivers and provide them with tools to operate economically, and consequently deepen and diversify the value that the customer creates through RI.

Concerning sustainable value proposition development in the context of a CE, different authors suggested what circular value propositions consist of (Fernandes et al., 2020). Extant research in CE suggests that CS should be measured against indicators such as access or availability, and result and performance (Kjaer et al., 2019; Pieroni et al., 2019). The presented research differentiates from the extant research and argues that 'circularity' cannot be an inherent part of a value proposition in a CS, but is the result of stewardship practice in the RI circular principles and strategies.

A means-end chain approach postulates a hierarchical linkage between attributes of products and services, the benefits that are consequences that result through the use or consumption of attributes, and the values of customers that form a chain of hierarchically-related elements and underlie the decision-making processes of customers (Botschen et al., 1997). The higher up in the means-end chain, the more abstract the elements of the chain become (Zeithaml, 1988).

Discussing each of the eleven identified value proposition elements would go beyond the scope of this research. However, some elements are worth mentioning. Previous research has identified "task simplicity and time efficiency of the processes that make up one's job" (Macdonald et al., 2016) and "better or easier life for the customer" (Nordin and Kowalkowski, 2010), which are similar to the most important value proposition component in the presented research, "the best tool for doing the job". Other benefits of CS, such as improved service quality (Raddats et al., 2016), quality of equipment and repairs (Toossi et al., 2013), fast problem-solving (Macdonald et al., 2016), and the improvement of the customer's processes (Macdonald et al., 2016), show similarities with

the benefits durability of the vehicle identified in this study. These promote higher productivity.

Low entry barriers for customers, with a lower budget, were identified in the study presented, and as well are previously discussed in the literature as a means to give customers access to more sustainable CS (Tukker, 2004). Visnjic et al. (2017) found that providers can realise economies of scale and scope by cross-leveraging resources and capabilities across products and services. EVCo uses these effects in that they do all improvement and development at their own expense, and by doing so retain ownership over the intellectual property and thus can improve the CS for all customers. Extant research identified the outsourcing and reduction of the risk to the supplier (Johnson and Mena, 2008) as the main benefit, so that customers can focus on their core offering (Johnson and Mena, 2008) and have minimised uncertainty related to processes and decisions involved in one's job (Macdonald et al., 2016). Interestingly, the respondents of the presented study have not mentioned risk reduction explicitly. However, it can be interpreted that many of the benefits, such as durable and improved vehicles, reduce the operative risk of the post customers.

6.2.2 Customers Achieving Their Goals

Value stems from customers' learned perceptions, preferences, and evaluations (Macdonald et al., 2016), and a customer's perceived preference for and evaluation of those product attributes, attribute performances, and consequences arising from use that facilitate (or block) achieving the customer's goals and purposes in use situations (Woodruff, 1997). The study presented is in line with Edvardsson et al. (2011) who argue that sustainable value is created through the integration of different resources which leads to the creation of different economic, social, and environmental ViU constructs.

Sustainable value is interactive, relativistic, and meaning-laden in a given context and allows one to achieve economic, social and environmental goals (Bocken et al., 2013; Hart and Milstein, 2003; Upward and Jones, 2016). Xing et al. (2013) argue that the functional attributes of products and services are correlated to their functional and

physical capabilities to serve customer needs, and the value realisation is determined by how the customer evaluates the configuration of functions provided by the system. The empirical evidence of this study using means-end chains not only argues that there is a correlation but also a clear causality, that leads from the attributes to the created ViU.

A company's goals focus on particular outcomes it wants to achieve (Findsrud et al., 2018), which drive and direct the motivation to engage in processes that turn needs into goals (Taylor et al., 2019). Different stakeholders, past experiences within and outside of a business relationship, and the institutional environment (Eggert et al., 2019) influence a firm's goal setting, striving, and achievement (Taylor et al., 2019) and the intensity and persistence (Findsrud et al., 2018) with which they seek to realise value from CS in order to achieve their goals (Macdonald et al., 2016). The case of EVCo confirmed the nature of CS, that each new customer has a new CS and therefore a value proposition that over the lifetime of the solution contract, continuously gets improved (Tuli et al., 2007).

Flint et al. (2002) argued that customer goals change over time, and so customers periodically change what they seek in CS, a phenomenon that the presented study confirms. Changes may occur because of an assessment of resources and the alignment of expected and experienced ViU or the customers external and contextual changes (Eggert et al., 2019). The study identified three significant changes in the EVCo's customer goals, which occurred over time. They are an increase in parcel delivery, uptime, and sustainability.

Macdonald et al. (2016) suggest that different perceptions of value exist and that ViU is created both at an individual and collective level. The tensions caused by the increasing complexity lead to a challenging situation for EVCo and the procurement and fleet departments of the customers as they need to co-produce CS that achieve multiple goals. Different customer internal stakeholders use CS to achieve their goals. In the instance of EVCo's mail customers it is, for example, that the operations achieve their economic goals, whereas the sustainability and communications department is more interested in the environmental goals achievable through the CS.

The ViU constructs identified in the presented study are predominantly economic goals, followed by environmental and social goals. Customers' interest to meet social and environmental goals varies considerably across geographies and markets, a phenomenon identified by Reim et al. (2019). If customers do not care about certain issues, then the benefits of changing towards a sustainable CS for safety and the environment will not attract them. This study illustrated this point, with potential customers in markets where the main decision factor in the procurement is low investment cost over low lifecycle cost with potential environmental benefits.

To create sustainable value it is in particular important, according to Hallstedt et al. (2020), to consider all three dimensions, because there is a risk of neglecting social impacts when avoiding ecological impacts. For example, the use of electric batteries may imply a shift to a material that is a conflict mineral, and in that way create another sustainability problem. There is, therefore, a risk that a sub-optimisation if not all dimensions are taken into consideration at the same time for all life cycle phases. Thinking in terms of the objective that needs to be accomplished and taking a fresh look at the system, according to Visnjic et al. (2017), allows the solution provider to create shared value for various stakeholders in the ecosystem.

6.2.3 Value-in-use constructs

The presented study using means-end chains found that the predominant ViU of the investigated CS helped to achieve economic goals, followed by environmental, and, finally, social goals. Depending on the intention of the study and the design, this result will differ. Blüher et al. (2020) for example, in a systematic literature review found that the predominant positive effects were ecological, followed by economic and social aspects. Both these findings suggest that sustainability goals in CS often are in favour of environmental and economic ViU, neglecting the social value.

6.2.3.1 Value-in-Use to Achieve Economic Goals

The study identified three ViU constructs: lower cost, growing business, and availability, that indicate economic value. Interestingly, availability was the least mentioned indicator

in the presented study but one of the most prominent arguments for CS in the literature. EVCo, as suggested in the literature (Gebauer et al., 2005), changed the focus of the CS from production efficiency to efficiency and effectiveness within the customer process and so minimises and avoids the non-productive time and downtime of the operations (Macdonald et al., 2016).

Customers know that the product utilisation will result in a certain amount of failures which will cause significant inconvenience. EVCo, through different mechanisms (Johnson and Mena, 2008), such as using replacement vehicles to ensure the fulfilment of availability contracts, aim to reduce that inconvenience. Therefore, customers choose the solution contract and pay an ongoing flat-rate fee under performance-based capability contracts to counter major availability related risk (Rapaccini and Visintin, 2015). These outcomes are principally measured in terms of asset availability, and EVCo does, as suggested by Baines et al. (2011), measure by the amount of time that a product or asset is available for use as a proportion of the scheduled availability. The goals are formalised in the solution contracts, where penalties are levied by the asset user for poor performance (Johnson and Mena, 2008). The contracts are individual to each customer, and as suggested by Reim et al. (2015), the provider has the freedom in each case to choose how they will ensure availability, such as repairing the vehicle on-site or replacing it with a replacement vehicle until the repairs are conducted. The provider may find that it is unable to deliver the agreed-upon outcome and can therefore be subject to delivery penalties (Visnjic et al., 2017). According to EVCo, however, it is a rare exception that the customers actually demand the penalty payment.

According to EVCo and the customers, the overall TCO is likely to be lower with the EVCo CS compared to their competitors. The lower operational cost has long been identified as a major argument for CS (Macdonald et al., 2016). The process orientation of CS implies that pricing policy is linked, to varying degrees, to outcomes delivered to the customer (Nordin and Kowalkowski, 2010). This, is the case of EVCo, where more elaborate mechanisms such as “gain-sharing” arrangements with payments directly linked to the customer’s business performance, as suggested by Nordin and Kowalkowski (2010), are not in place. Interestingly, one of the often-mentioned arguments in favour of

CS is the reduction of customers' fixed capital (Macdonald et al., 2016) and the saving of the customer money in terms of product ownership (Raddats et al., 2016). As EVCo does in all cases transfer the ownership of the vehicles to the customer, these savings are not applicable and in fact the high upfront costs are a major obstacle for many of EVCo's potential customers.

The change in the market environment of EVCo's customers, the change from posts delivering predominantly letters to delivering parcels, has been a huge opportunity for the post customers. Macdonald et al. (2016) identified that CS do not only provide a competitive advantage for the provider but as well have a positive impact on the customer's own market position.

6.2.3.2 Value-in-Use to Achieve Environmental Goals

The achievement of environmental sustainability goals is a major cornerstone of sustainable CS, with their potential to consume fewer resources throughout the entire life cycle by breaking the link between profit and production volume (Matschewsky, 2019; Yang and Evans, 2019). Although achieving absolute resource decoupling is likely only to be possible with result-oriented offerings, the (Matschewsky, 2019) conducted study identified ViU constructs along the beginning, mid, and EoL of the CS.

The most obvious ViU to the customer is the reduced resource consumption in the use phase as electric vehicles are less polluting, more energy efficient, use fewer consumables, and require less maintenance. Both customers and manufacturers have the incentive to increase resource and energy efficiency in the use phase of products. Nevertheless, how advanced the CS is (Yang and Evans, 2019). A key premise of sustainable CS is that if solution providers retain ownership of products, they are incentivised to use products as efficiently as possible in terms of materials and energy in order to reduce costs (Tukker, 2015, 2004). In the presented case, the customers buy the assets, but if they would pay per use or service kilometre, the efficiency could further increase and reduce consumption and costs.

The study provides no evidence to support or refute the assumption that an outcome-based business model would increase efficiency. The customers reportedly can increase their product use (Tukker, 2004), which is oftentimes stated as a strong contributor to achieving environmental sustainability goals, because the vehicles are longer on the road and have fewer breakdowns. They are as well more versatile, which leads to dematerialisation. Dematerialisation (Yang and Evans, 2019) is often mentioned in connection to sustainable CS and refers to the total reduction in the use of materials, energy and products, because the same number of products can meet the needs of more people. In the presented study, that is the case because electric vehicles are more versatile than their combustion engine counterparts and can be used for delivering both mail and parcels.

The ViU creation in the case presented is greatly dependent on information technology, for both ensuring the longevity of components but as well to monitor and analyse the route and driver behaviour of delivery staff to be the most energy efficient. Hallstedt et al. (2020) in their study observed, as the presented study suggests, good examples of sustainability advantages through tracking real-time data during usage phases to avoid extra repairs or to optimise maintenance, can be achieved. However, both studies suggest that these more resource-efficient and sustainable service-oriented and digitalised solutions are not purposely developed to enable more sustainable CS but increase profitability and that additional potential exists to deliberately create solutions that could give a company a business advantage, and at the same time contribute to a more sustainable society.

ViU use to achieve environmental goals is created both at the beginning and the EoL and is, given the nature of loops, however difficult to pinpoint. For example, part harvesting at the EoL reduces the need for parts from virgin materials at the EoL. For the customer in a CS, many of those activities are not directly visible but reduce their overall carbon footprint. The environmental impact potential of a CS is mainly subject to material and energy consumptions related to how the products, as assets, are developed, operated, and managed over their whole life (Xing et al., 2013). Tukker (2004) identified the freedom to design for sustainability as an important requirement for CS and the study confirms that, because in most cases the solution provider has full control over the design of their

solutions. Further, they remain the intellectual property of all the customised solutions and can replicate designs for other customers.

Bocken et al. (2014) suggest different strategies to reduce the flow of material through the economic system, such as slowing down and closing resource loops. When slowing down resource loops, solution providers through the design of long-life goods and product-life extension (i.e., service loops to extend a product's life, for instance through repair and remanufacturing), increase the utilisation period of products. Usage is extended and/or intensified, resulting in a slowdown of the flow of resources. When closing resource loops the providers through, for example recycling, close the loop between post-use and production, resulting in a circular flow of resources. Extant research (Bocken et al., 2014; Kalmykova et al., 2018; Tukker, 2004) is oftentimes concerned to categorise business models and attribute characteristics. The case of the electric vehicle manufacturer however portrayed what probably most companies are, that is to say, a mix of different elements that increase sustainable value. As suggested by Yang & Evans (2019) the supplier has an interest in taking back the equipment after the contract expires to remanufacture them and reuse parts. Reuse of parts results in less consumption of virgin materials and produces savings in the transport of new parts. However, it is important to consider that transportation can negate all the reduction of environmental impacts stemming from improvements of products and reuse and recycling of old parts and even from shared use (Mont et al., 2006). It is therefore important to have local service providers (Baines et al., 2007) that services (such as maintenance and repair) can avoid products or components being thrown away unnecessarily and can extend product life to some extent, without sending them once around the globe.

6.2.3.3 Value-in-Use to Achieve Social Goals

The findings show that CS have positive effects on improving the environmental and economic sustainability of solution providers, but minor social benefit on social value – an observation previously made by Yang and Evans (2019). Nevertheless, the study revealed two ViU constructs, corporate citizenship and safer vehicle use, which help customers achieve their social goals.

The post companies in the study conducted see themselves as community builders and connectors who operate ethically and sustainably and try to not impact society at large negatively through their operations. Environmental and social policies and regulations issued by governments and supranational organisations are critical sustainability drivers which firms have to comply with or risk legal consequences, and negative effects on reputation and image (Porter and Van der Linde, 1995). This is a circumstance which is particularly important as the customers in the presented study are government-owned and have a role model function.

Corporate citizenship, according to Smart et al. (2017), is concerned with the democratisation of environmental and social issues and how organisations engage with civil society, not-for-profit and governmental organisations and encompass the business case and ideological issues of companies. The business case is concerned with how organisations benefit from engaging in corporate social responsibility policies, activities and practices and addresses the needs of employees in the workplace to promote equity, development and well-being and the various ideas revolving around stewardship practices, such as addressing issues like through market externalisation via extended supplier responsibilities/relationships, or by internalising social and environmental impacts through sustainable procurement practices that support local communities.

Ideology is concerned with the contemporary relevance of beliefs that fortify western business operations and question the dominant capitalistic economic paradigm, with an argument for corporations to create shared value (Porter and Kramer, 2011). This encourages businesses to improve the conditions of the communities they operate in, whilst simultaneously enhancing their own competitiveness. Shared value suggests creating social benefit along with financial profit and therefore strengthening the communities the company is embedded in, not only focusing on short-term financial performance. Social needs and not supply and demand create markets, and if the needs are not met, they sooner or later occur as costs.

Creating shared value and connecting a company to its community can be achieved in three ways. These are reconceiving products and markets, redefining productivity in the

value chain and building supportive industry clusters at the company's location. Companies therefore have to create products that are *good* and made with an intention on the identified needs of society (Porter and Kramer, 2011). The customers portrayed in the study represent both sides of Smart et al.'s (2017) description of corporate citizenship, as through their use of electric vehicles the value for the society is created because of less resource consumption and the reduction of noise and air pollution, and because the companies on an ideological level interact with the society and their customers and are a role model for more sustainable business.

As the study revealed, service and remanufacturing work is labour-intensive and can offset the loss of jobs to automation in traditional manufacturing (Baines et al., 2007). In fact, Stahel (2008, 1984) advocated the positive impact of an economy in loops not only on waste prevention, resource savings, and economic competitiveness but as well job creation, which solidifies CS as a means of corporate citizenship.

The findings exemplified how CS can help achieve social goals through safer vehicle design and use. The study supports the findings by Yang and Evans, 2019 (2019) who suggest that no matter the level of service ML, servitization can increase safety because they are designed, built, and maintained in a more user-centred fashion than in a product ML and the users' feedback is valued more. The reduction of injuries and the employee's safety is for many companies of the highest importance. The safe use can be increased because the provider bares risk caused by human activities involved in CS, such as the inappropriate or non-efficient use of equipment, and by doing so can learn how to improve the CS (Ng and Nudurupati, 2010). Smith et al. (2014) in their study on maintenance contracts in the defence industry argue that the effective and safe use of the equipment is a vital part of the value propositions and a key requirement to achieve the customers' goals, which this study strongly supports.

6.3 Institutional Logics Perspective

The service-ecosystems of CS comprises the lead firm (Perks et al., 2017) that envisions the value for all members and multiple stakeholders, such as customers, suppliers, and civil society (Hart and Milstein, 2003) and form organisational fields (Scott, 1995; Wooten and Hoffman, 2017). These stakeholders are increasingly well connected through technology, and organisations need to be more transparent in response to a well-informed and active stakeholder base (Hart and Milstein, 2003). This requires the acquisition or development of new organisational skills, resources, and functional competencies to match the requirements to be both competitive and comply with regulations and society's expectations (Miemczyk, 2008; Yang and Su, 2014). These actors within and outside of the service ecosystem imbue an organisation with legitimacy, the 'congruence of an organisation with social laws, norms, and value' (Wooten and Hoffman, 2017).

6.3.1 Isomorphism

Corporate legitimacy, the social acceptance of corporate practices and congruence of an organisation with social norms values (Deephouse et al., 2017), is critical to the survival of corporations because it is a precondition for the continuous flow of and access to resources such as skilled workforces and investment capital (Deephouse et al., 2017). In recent years, access to capital at good rates exclusively for sustainable products and companies has been of great interest in the finance industry to those firms wanting to practise stewardship. Isomorphic pressures can drive the adoption of stewardship practice, which has been previously researched (Caldera et al., 2019; Dagiliene et al., 2020; Ranta et al., 2018b).

Institutional isomorphism acts through regulative, cultural-cognitive, and normative elements which impose boundaries on organisations but also support and empower them. The corresponding coercive, normative, and mimetic processes that bring organisations facing the same environmental conditions to resemble the other organisations' structures and practices, i.e. isomorphism (DiMaggio and Powell, 1983). Coercive processes are

determined by formal (e.g., European directives on extended producer responsibility) and informal (e.g., corporate social responsibility) pressures on organisations.

Coercive pressure acts through laws and rules and organisations make decisions to avoid sanctions. Normative pressure originates from binding expectations of social norms and stems from both professionalisation, which is determined by formal education and professionals (e.g. BSI guidelines to implement CE in organisations or Cradle2Cradle certification for products) as well as what is viewed to be appropriate and socially accepted (e.g., corporate citizenship to ‘to do the right thing’).

Mimetic processes imply the imitation of other organisations and adopt best practices from successful actors to avoid uncertainty and increase efficiency. That, for example, manifests as assessment and benchmarking exercises for companies. Institutional analysis using the three isomorphic processes is by far the most common application in research on CE and Institutional Theory as institutional pressures arguably are one of the main drivers of ‘sustainable’ practices in organisations (Calzolari et al., 2021; Ranta et al., 2018b) and the most important factor behind sustainable CS because they cover regulatory, societal, and industry-specific aspects of doing business.

The isomorphic pressures in service ecosystems manifest particularly in the value creation of CS. Extant research suggests that a service system at a meso-level emerges to create ViU for the customer and is embedded, and not separated, in a functional social system with a clear purpose explained through goal achievement and control mechanisms (Edvardsson et al., 2011). The ViU for the customer is determined and coordinated by these social structures, the institutional logics (Edvardsson et al., 2014). These logics are the socially constructed values and beliefs by which individuals put meaning to their social reality and are grounded in norms and rules aiming at achieving a specific desired state in a society or a group of actors (Edvardsson et al., 2014; Thornton et al., 2012). Exploring the phenomenon of CE from an institutionalist perspective (Storbacka, 2019; Widmer and Prior, 2019) allows us to better understand RI as actors’ practice on a micro-level and by doing so overcome the macro-level view of Institutional Theory. Considering the importance of environmental sustainability to some of the actors in the service

ecosystem, practising stewardship is a change in the institutional logics that are activated in the service ecosystem. These manifests in institutional legitimacy, agency, and field-level practice and ultimately forms a new hybrid logic.

6.3.2 Field-Level Practice

The change towards a CE happens in the nexus between the social context at a macro level and the activities at a micro level (Lieder and Rashid, 2016). This view on a nexus is supported by research that describes service ecosystems as aggregate levels which are nested and intertwined (Akaka et al., 2013) with actors that interact across these levels. Practices (Frow et al., 2019) and institutional structures (Akaka et al., 2013; Pop et al., 2018) manifest in each layer (Pop et al., 2018), and what happens at one level, intended or unintended, affects other levels. The present study in particular focuses on the RI practice to characterise a change towards CE.

The transformation from a linear to a CE is a lengthy process and every actor in a service ecosystem can take on agency and be an advocate for CE (Fligstein, 2013; Widmer and Prior, 2019). Salient actors use different narratives to mobilise resources to make CE as institutional logics the prevalent belief (Hardy and Maguire, 2017). The struggle of changing the institutional environment from within the system is discussed in the literature as the paradox of embedded agency (Garud et al., 2007). The paradox describes how institutional entrepreneurs take on agency in changing the very system (i.e. linear economy) they are embedded and subject to the regulative, normative, and cultural-cognitive pressures, develop new practices (i.e. circular economy) and subsequently get others in the system to adopt these practices (Widmer and Prior, 2019). An example of such a salient actor in the presented study is EVCo which drives a sustainability agenda, indicating agency and shaping of logics in the field. The company is, for example, developing a freely available battery-recycling process to close the material loop and increase the circularity of their products, but lacks bargaining power because it is small-scale production. The company has no leverage to convince the Chinese manufacturer of the batteries to produce them in a way that they are dismantlable. EVCo is however

convinced that increasing collaboration with suppliers and building trusted relationships can be a lever when trying to develop more sustainable CS with suppliers.

From a theoretical perspective, practising stewardship can be seen as an attempt to adhere to institutional prescriptions, as postulated by Institutional Theory (Scott, 1995). The presented study confirms previous work in that stewardship practice comprises different operation techniques (Caldera et al., 2019) and is driven by eco-innovation (Choudhary et al., 2022). The presented study used CE principles (see Section 2.3), the micro foundation of the RI practice at a field level in sustainable CS to describe stewardship practice and subsequently used those principles in the two case studies in Chapters 4 and 5 to identify stewardship in the RI practice of solution providers. Previous studies using Institutional Theory have identified stewardship practices (Calzolari et al., 2021; Dagiliene et al., 2020; Fuchs and Hovemann, 2022) and found that recycling, using renewable energy, and increasing energy and resource efficiency are the most commonly used practices both observed by researchers (Calzolari et al., 2021; Fuchs and Hovemann, 2022) and reported by companies (Dagiliene et al., 2020). The presented study found that some practices are used more commonly than others, and confirms previous observations that suggest that reducing, reusing, and recovering are less common, as they are new approaches (Calzolari et al., 2021).

6.3.3 Circular Economy as Hybrid Logic

The presented study suggests that CE is a hybrid logic, highlighting the dual objective to achieve economic and environmental sustainability, through a shift from a traditional to a production logic, and in the case of CS, from a product to a service ML. The institutional logic refers to the belief systems and its related practices that predominate in an organisational field' (Scott, 2003, 1995). Institutional logics represent a shared understanding and bonding among firms in the field. In the context of the presented study this is the service ecosystem. Therefore, a change in dominant logics shifts the attention of firms towards actions that conform with the new paradigm, which ultimately induces change (Thornton and Ocasio, 2008).

Previous Institutional Theory research in an industrial setting has been interested in the dichotomy between efficiency (cost minimisation, profit maximisation) and legitimacy (sustainability) (Do et al., 2022). The presented study strongly agrees with Do et al. (2022), who argue that CE facilitates the attainment of both economic and environmental value, and labelled the CE logic as legitimacy-embedded efficiency. Extant research in servitization has focused on efficiency, whereas research in sustainability has focused on legitimacy. Sustainable CS offer a good balance between the two and embed both legitimacy and efficiency.

The data suggests a hybrid logic that incorporates both environmental and commercial issues and that the commercial logic is dominant. There is, however, evidence that this hybrid logic can be replaced by purely commercial logics. This happens when the economic performance of the company decreases, and the environmental logic must be neglected to ensure the financial success of the company. In other words, EVCo explained that they could only be concerned about sustainability and activate the environmental logic if they are profitable. This indicates tensions in activated logics. From a RI perspective, it can be argued that the service-ecosystem is one field, from a service ML perspective, different competing logics are dominant in the different spheres. The findings suggest that in the provider sphere in which EVCo with their suppliers creates ‘potential’ value, the commercial logic upstream on the supply chain is dominant and there is no evidence for increasing stewardship from material or component suppliers. This is particularly evident with EVCo’s efforts to close resource loops. In the joint and customer sphere, the spheres in which ‘real’ value is created or co-created, EVCo, service-partners, customers, and end-consumers in addition to the commercial logic partake in the common logic of environmental sustainability.

Institutional Theory manifests through the organisational field practice, as the logics on a macro level coordinate the RI at a micro level. Drivers for and barriers to the change towards sustainability can be exogenous (external) and endogenous (internal) (Schrettle et al., 2014) as well as in the means and goals (Santos and Pache, 2010). In the presented research, the drivers represent instances of synergies which result in a win-win situation for all actors, and barriers caused by tensions and trade-offs that result in a win-lose

situation. There is a relationship between the drivers and barriers, that is that they are essentially different outcomes of the same root tensions, the plurality of logics. This argument suggests that a hierarchical relationship between the concepts of synergies, tensions and trade-off exists (Haffar and Searcy, 2017)

Synergies that lead to win-win situations are the result of sustainable PL being compatible with a service ML. Barriers in service-ecosystems of CS can occur when logics are competing or conflicting (Hahn et al., 2018), and these competing and conflicting logics foster challenges of external legitimacy and internal conflict that need to be resolved by implementing effective structures at the organisational and field level (Smith and Tracey, 2016). This requires a balanced consideration in all sustainability dimensions to sustain competitive advantage (Hart and Milstein, 2003) with present tensions in shared value creation being internally related to cost and risk reduction and externally to the company's reputation and legitimacy to operate. The tension between profit-maximisation logic and sustainability logic could thus lead to a trade-off between a more cost-efficient and more environmentally friendly production method. The data suggests that basic values are in hierarchical order safety, profitability, and sustainability.

In the context of CE, the tensions manifest as implementation barriers. From an institutional point of view, this has been previously investigated by just a few researchers (Caldera et al., 2019; Choudhary et al., 2022; Dagiliene et al., 2020; Do et al., 2022; Ranta et al., 2018b). The presence of both the requirement of profitability and sustainability produces a circular logic, away from a linear logic that just had sustainability reporting, to a hybrid logic here sustainability is actively requested and worked towards. The different actors such as EVCo, suppliers, and service partners all play their roles to facilitating benefits that enable value creation for the different customers and their end consumers. These actors all partake in a common meaning system, which is commercial profitability. However, only EVCo and their customers' value co-creation is coordinated through the institutions and institutional arrangements of CE. The subsequent Sections 6.4 and 6.5 discuss the drivers and barriers to a CE hybrid logics, with the drivers derived from the findings of the single-case study (Section 5.4) and the barriers derived from the multiple-case study (Section 4.4).

6.4 Barriers to Sustainable Customer Solutions

The revealed barriers in the context of this study are instances in which internal or external demands hinder the manufacturers in practising stewardship. These instances are caused when servitization efforts have negative effects on stewardship efforts, and not vice versa (i.e., stewardship effects servitization). These barriers stem from the findings of the multiple-case study in Chapter 4 and are identified through the tensions and trade-offs resulting from the service ML conflicting or competing with a sustainable PL.

Analysing the barriers through an institutional lens led to equivocal results, as some of the higher level internal and external barriers can be resulting from both normative and mimetic pressures. The discussion of the findings is novel as the barriers are categorised and differentiated between internal or external to the solution provider and discuss whether they are in the functional means or the ideological goals of the organisation (Santos and Pache, 2010). The key distinction between tensions at the means and at the goals level are that demands that involve conflict prescribing goals are legitimate to pursue (which may or may not involve conflict at the means level). Demands that are harmonious at the level of the goals may yet lead to a dispute about the means (functional strategies, processes, and practices), required to achieve these goals. Functional and process demands are material and peripheral and, thus, are potentially flexible and negotiable. In contrast, goals are expressions of the core system of values and references of organisational constituencies and are, as such, not easily challenged or negotiable. Institutional demands can be motivated by either increasing efficiency or legitimacy, or both (Section 6.3.3). The various barriers subsequently described are barriers to achieving goals, and these goals, therefore they are barriers to legitimacy and efficiency. There therefore likely exist a causal relation between barriers to achieving goals.

6.4.1 Internal Representation of Transformation Challenges

6.4.1.1 Culture

The findings suggest that the culture is a major internal barrier to increasing stewardship practice and has been previously investigated using Institutional Theory, namely the

employee attitudes (Caldera et al., 2019; Choudhary et al., 2022), the lack of management commitment (Dubey et al., 2018), and the lack of incentives (Dagiliene et al., 2020). In the case of CableCo', for example, barriers are cultural in relation to increasing servitization. There is potential to increase stewardship through servitization, but significant technological barriers to stewardship exist and would require major investment in R&D to increase stewardship. Management commitment for this is lacking. Although the data revealed no active resistance towards sustainability, which according to (Shahbazi et al., 2016) does happen as employees resist change that affect a fundamental change in the company culture (Guldmann and Huulgaard, 2020). Sufficient empirical evidence indicates that employees just simply do not care about practising stewardship. Negative attitudes and limited environmental motivation and awareness among employees has been identified as a barrier by (Shahbazi et al., 2016) and can be confirmed with the study presented here. The data suggests that in some cases effective employee empowerment and engagement activities (Yadav et al., 2020) were lacking as interviewees indicated that they had ideas which were not acknowledged and left them powerless. This occurred in particular when it involved other departments which indicates that silo thinking, as suggested by (Tura et al., 2019a), is a barrier to stewardship practice. What the findings highlighted is that the limited attention for EoL phase in current product designs is a significant barrier towards sustainability (Masi et al., 2018).

Different studies have previously identified that the poor management commitment and awareness of sustainability initiatives result in a lack of awareness and sense of urgency (Guldmann and Huulgaard, 2020; Masi et al., 2018; Shahbazi et al., 2016). This is a finding confirmed by the presented study. Overall, the cultural internal barriers identified in this study confirm that companies still have a narrow focus of sustainability (Guldmann and Huulgaard, 2020) and don't regard sustainability as a proactive practice (Kirchherr et al., 2018), while having traditional incentive structures and performance metrics that are inappropriate for sustainable CS (Guldmann and Huulgaard, 2020; Paletta et al., 2019). Organisations lack in education, support, and guidance for stewardship practice (Shahbazi et al., 2016). From an institutional perspective, the cultural barriers are normative and are formed by the goals of the organisations. This makes overcoming them

inherently more complicated to overcome than mere technical issues. Studies such as Do et al. (2022) and Ranta et al. (2018b) have identified the perception of EoL and bi-products as “waste” instead of “resources” as a major obstacle to changing towards a CE, as in a CE “waste does not exist”. Overcoming these cultural barriers, therefore, poses risk for all companies that are not to be neglected.

6.4.1.2 Capabilities

Although the study did not identify the lack of certain capabilities as a great barrier towards increasing stewardship, some capabilities are described in the literature that are required for successful stewardship practice. Companies require special product and service design capabilities (Sousa-Zomer et al., 2018) which companies in this research are just about to build up. One example for this is the case of EVCo which used an outdated design that is not made for remanufacturing and requires parts to be shredded for recovery. They only learned this once the manufacturing operation had been running for several years. Remanufacturing requires considerable expertise and knowledge of the product, since the product is to be restored to original or better condition, a challenge identified by (Guldmann and Huulgaard, 2020; Sousa-Zomer et al., 2018). The product may also require redesign, not least to become suitable for remanufacturing. The companies in this study did not regard these design capabilities as barriers, but more as an engineering challenge to be mastered.

An overall lack of technical and technological know-how (Tura et al., 2019a) and their application to design and engage in new sustainable business models (Guldmann and Huulgaard, 2020) is slowing the transition towards increasing stewardship practice. For example, in the case of CableCo, the company manufactures passive components which are difficult to servitize, and many of the existing products are resource intensive and based on existing technology and locked in by physical limitations, with high investment cost for every change in the customers’ products. Similarly, PumpCo’s barriers are in the capabilities to harvest the potential of increasing stewardship through servitization. The company already has a very service-oriented culture but lacks service-specific innovation process that complements with resource stewardship. Engineers and sales staff

overemphasis on the product highlighting that it is not possible to servitize “stupid products” which indicates a lack the tools to servitize, a challenge identified by (Sousa-Zomer et al., 2018) as well as (Guldmann and Huulgaard, 2020).

Previous studies have identified barriers caused by lack of knowhow and capabilities as both normative because the professionalisation is not yet advanced enough (Caldera et al., 2019), as well as mimetic (Do et al., 2022), because old practices are prevailing and new and better practices towards stewardship are lacking. The presented study suggests that the cause is neither normative nor mimetic, but both with salient actors in the service ecosystem slowly introducing novel practice that later are mimicked by other actors and slowly transition towards being normative. The lack of capabilities indicates that the barrier is predominantly at the means level and could be overcome and is not fundamental at the goals level.

As both sustainable production and servitization are recent developments, management and decision-making support tools and performance indicators are lacking. Different research has highlighted this problem (Kirchherr et al., 2018; Masi et al., 2018; Shahbazi et al., 2016; Tura et al., 2019a; Yadav et al., 2020) to ensure the development of long-term benefits of circularity which is required to communicate reliable data and information to employees and other stakeholders because most economic indicators were made for linear economies (Masi et al., 2018; Yadav et al., 2020). Interestingly, none of the accounts in this research has mentioned the lack of indicators as a barrier to increase stewardship. Dagiliene et al. (2020) identified the lack of KPI on various dimensions of product’s prolonged life cycle as a normative barrier towards CE and arguing that disclosures of reuse, recycle and recover information in the reports of manufacturing companies do not portray stewardship practice sufficiently. The authors further argue that the voluntary and selective reporting practice pose an additional barrier. This may explain why none of the companies in the presented study identified the lack of KPI as a barrier – because they had no intend to report on it.

6.4.1.3 Ambidexterity

A challenge discussed in both literature on servitization (Lütjen et al., 2017) and sustainable CS, is ambidexterity. Manufacturers face ambidexterity challenges in the stepwise transformation when specific sectors, such as sustainable CS, are growing, while other parts of the business which have a traditional product-focus remain. When changing the ML, for example, it is most challenging, as product-based businesses mostly focus on efficiency and standardisation, while at the same time, heterogeneity and flexibility are required for running a service business. The introduction of sustainable business models may cannibalise existing business and lead to decreased sales because of longer-lasting products or decreasing sales due to increased repaired, reconditioned, and remanufactured products. The risk of implementing sustainable practices in CS poses a mimetic barrier (Caldera et al., 2019).

Most of the examples for a business case are conceptual and only a few successful best practices exist. EVCo, for example, struggles to develop value propositions in which higher level of servitization, such as increasing uptime through predictive maintenance, added customer value. A good economic performance of the company is required to practise stewardship, as remanufacturing is risky, and margins are lower. Maintenance during the use phase or taking care of vehicles in use doesn't matter as the effort for putting vehicles into 'as new' condition is the same, regardless. This cannibalisation of the own product market was identified as a major barrier to manufacturing firms by (Bressanelli et al., 2019; Guldmann and Huulgaard, 2020; Sousa-Zomer et al., 2018).

The presented study found no evidence of cannibalisation. If anything, the opposite applies. For example, in the instance of EVCo the remanufactured vehicles complement the existing product portfolio. Barriers related to ambidexterity are arguably both at the means and the goals level. The mimetic pressures relating to best practices on how to manage ambidexterity indicate challenges concerning the functional means, the cultural barriers regarding the prioritisation, however, suggest that the barriers are as well at the goals level.

6.4.2 External Representation of Transformation Challenges

6.4.2.1 Market

External barriers related to the market and the customers of the solution providers pose a substantial barrier towards implementing sustainable CS. Previous research has identified these market related barriers as normative. They in particular highlight that organisations lack external expectations and pressures and their actions are not questioned (Dagiliene et al., 2020), trust in more sustainable alternatives, and the mimetic and social pressures related to the preference of new over reused products (Ranta et al., 2018b). Most of the market-related barriers are at the goals level and are concerned with the fundamental beliefs of customers and end consumers, which are most difficult for the solution provider to change.

No interest in sustainability

In the transformation towards a more sustainable PL, the manufacturers face customers that are not welcoming to the new, more sustainable value propositions. Unsustainable cultural behaviour and established habits will act as potential barriers in the transition towards a CE, as it will challenge the status quo, a phenomenon observed by different previous studies such as (Bressanelli et al., 2019; Guldmann and Huulgaard, 2020; Singh and Giacosa, 2019; Whalen et al., 2018).

The findings of the present study confirm this barrier. With examples in all three cases. The markets CableCo supplies, and the automotive industry in particular, traditionally does not have a keen interest in the EoL of their products. Cars typically end up in a scrap yard and get shredded and thermally recovered, and in infrastructure, cables would be used for decades. In the lengthy period between manufacturing cables and their EoL, CableCo loses the connection to their customers. EVCo reported that their customers in the beginning were reluctant to test new equipment but overcame the mistrust because the technical superiority of the products help to develop the relationship. That then leads to increased collaboration, whilst developing future products and solution and during the product use period, to satisfying the needs and offer a solution to the customers' problems.

This exchange and servitization contracts with all customers allow a transparent understanding of the Total Cost of Ownership (TCO) in different environments. EVCo, however, reported that for some potential customers, they struggle to convey the value proposition as not all are interested in the TCO of their fleet, but are foremost interested in low investment cost, rather than quality and longevity.

Shareholders with a short-term agenda still dominate corporate governance, and have interests in this status quo (Guldmann and Huulgaard, 2020; Masi et al., 2018; Pedersen et al., 2019; Yadav et al., 2020). The predominant perception of low economic returns and no interest in having a long-term perspective poses therefore a significant barrier to becoming more sustainable. Some, for example, have different funds for financing asset investment and maintenance, which is challenging, as a lower TCO is at the core of EVCo's value propositions. These challenges are known from the servitization literature (Coreynen et al., 2017; Helms, 2016). Tura et al. (2019a) found that region-specific and local cultures hamper the implementation of new sustainable CS, a finding that the presented study confirms. Most customers of PumpCo, for example, are not interested to reduce cost in the long-term, but are focussed on the initial investment. The company reports that this lack of interest in more sustainable CS is in particular present in the Middle East and Asia, whereas customers in Europe and North America are more open so sustainable CS. Further, the margins and benefits are too low to increase efficiency, to make it green, if it comes at a premium.

Fashion vulnerability and inferiority of products

Customer acceptance for more sustainable business models further face the problem of fashion vulnerability. Long-life products may be unable to respond to fast fashion changes and holding up with technological development (Guldmann and Huulgaard, 2020; Linder and Williander, 2017). The phenomenon is predominantly known from consumer markets, where the attractiveness of an offer is partly based on aesthetic attributes of the product. Remanufacturing places increased demands on product design for modularity and/or timelessness. In the study presented, fashion vulnerability was identified in the case of EVCo where their customers retire the vehicles after seven years

to replace them with newer looking models, even though the vehicles could last longer in use. Interestingly, the study suggests that customers of EVCo's have no bias against remanufactured vehicles. Previous studies by (Singh and Giacosa, 2019; Whalen et al., 2018) found that consumers do not realise that repaired or refurbished products can be as good as new ones and expect worse performance of services and have hygiene issues. Hopkinson (2018) further found that the branding of refurbished or remanufactured goods is problematic, as customers are concerned not to have equal quality as compared to new products. Both issues were not found in the presented study of EVCo's remanufactured vehicles.

Data concerns

A barrier towards sustainable CS is mistrust. because customers are accustomed to the concept of acquiring goods, which poses a cultural barrier (Helms, 2016). They are also reluctant because of data security (Coreynen et al., 2017). The issue has been identified in both literature on servitization (Coreynen et al., 2017; Helms, 2016) and sustainable CS (Bressanelli et al., 2019; Whalen et al., 2018) and was as well identified in the study presented. Customers may not appreciate servitized offerings as they distrust that companies are capable of offering servitized products. For example, they may fear that valuable information may be shared with entities outside the firm. PumpCo would be interested in expanding its service level and move towards, for example, outcome-based contracting. However, the customers are not willing and interested in integrating suppliers this deep into their operations as they fear the loss of control and proprietary process parameters to competitors. Because the customers don't want to share too much information about the processes, there is in some cases only little insight into the customer's operation, as it is confidential.

CableCo, with one exception, only produces and sells passive components, and in some cases in highly commoditised markets in which manufacturers only win through cost leadership. Many CS for increasing stewardship through servitization require the 'Internet of Things' and digitalisation, and therefore active components, which makes it challenging to develop a convincing servitized value proposition. Increasing stewardship

through digitalisation would require the measurement and data from the 3rd party that produces and installs the components to measure the use of the product. This is challenging, as the company in some cases is in the 3rd or 4th tier. Expanding the value proposition into active components would bring new challenges, such as ownership and privacy of data.

Changes in consumer

Barriers in the market on a societal level are changes in consumer behaviours. In the case of EVCo, the delivery times are continuously expanding, which leaves less time for service, maintenance, and repair. The downtime of vehicles must be ever shorter because of multiple routes a day, due to increased consumerism. The issue of consumer behaviour has been previously identified (Bressanelli et al., 2019; Sousa-Zomer et al., 2018). However, the study presented exemplifies how that affects a company upstream. These changes pose a challenge to equipment and personnel because both EVCo and the post companies not only have the challenge of operating more sustainably, but as well increased business complexity. Given the relative size of EVCo compared to their much larger customers, increasing the service level, for example, to outcome-based contracting, has no benefit to the customer as it is more profitable for them to have built the capabilities in-house and buy the vehicles. The lack of proof for added business value and large-scale demonstration of sustainable CS has been identified by (Kirchherr et al., 2018; Pedersen et al., 2019; Tura et al., 2019a). This study confirms and expands these previous finding.

6.4.2.2 Service-Ecosystem

The literature on sustainable CS has identified different challenges and barriers concerning the service-ecosystem of manufacturers, because the focal firm may be the salient actor, their partners may not be ready, and the required infrastructure may not be available. The identified instances that lead to barriers related to the service ecosystem can be explained through both normative and mimetic pressures and both at the means and in the goals level. The focal manufacturing firm faces lack of interest and understanding from actors in the service ecosystem because of lack of awareness, knowledge, and competencies of sustainable standards (Guldmann and Huulgaard, 2020).

Furthermore, the values of participating actors along the supply network must be aligned for the adoption to sustainable CS, but suppliers are operating in a linear system (Guldmann and Huulgaard, 2020; Kirchherr et al., 2018). The price continues to be one of the determining factors over sustainability, and virgin materials are in many cases cheaper than recycled materials (Guldmann and Huulgaard, 2020; Kirchherr et al., 2018; Masi et al., 2018; Pedersen et al., 2019). Also, the price of new products is too low relative to the associated high costs of collecting, sorting and processing, for example, electronic equipment (Paletta et al., 2019; Whalen et al., 2018).

Smaller companies lack the bargaining power and trust to change their supply chain partners and may not be able to find suitable partners, which is a challenge as the entire supply chain has to change. This factor is even more critical in transforming towards circularity. As a small manufacturer, EVCo struggles to integrate their suppliers more into the supply chain and offering a more integrated CS. This is in particular a challenge, considering the EoL of vehicles and batteries. For example, as the importer and distributor of batteries, EVCo. is responsible for the correct disposal of EoL batteries. However, their supplier has no interest or intention to change the design and make the batteries easier to recover or take them back. The lack of support from their suppliers means that all recycling arises out of their own effort and at their own development cost.

A similar barrier to the end of the first life of vehicles is concerned with the cladding. Although EVCo. recovers resources with a high material purity from their remanufactured vehicles, such as the ABS cladding, there is no market for the recovered material, as the raw materials are too cheap. So, they get incinerated because they have dirt and debris from the use on them. Irregular and significant peaks of waste markets and fluctuating oil price and recycled plastics availability have, for example, been identified by (Paletta et al., 2019) as a barrier to achieving a more circular economy. The findings of the research presented confirm that companies who decide to move towards a sustainable PL may experience difficulty in finding appropriate supply chain partners (Bressanelli et al., 2019). With appropriate skills and a CE approach the lack of mature/knowledgeable suppliers are required for a successful industry collaboration to catalyse efforts and reduce cost, as well as competition that would naturally lower cost

(Veleva and Bodkin, 2018; Yadav et al., 2020). It takes time to build new partnerships and mutual trust, and there is reluctance to involve external stakeholders in sustainable business model innovation activities and often there is no clear responsibilities and ownerships in CE projects. There might be considerable challenges associated with creating the required understanding and incentives for key partners, such as retailers or service partners, and supplier, as the move to a CBM influences and must be compatible with the business models of these firms, as well as the initiating firm. It is in particular difficult to influence suppliers as a small company (Guldmann and Huulgaard, 2020; Heyes et al., 2018; Linder and Williander, 2017; Sousa-Zomer et al., 2018; Tura et al., 2019a).

A similar problem was identified in servitization, that is that manufacturers lose contact to their customers. Manufacturing companies move up the supply chain and lose contact to the end customer and have no direct contact if their products are integrated by system integrators. This restrains them from developing proper servitization (Finne and Holmström, 2013).

A barrier to increasing stewardship known in the literature are relationship issues based on the position in the value chain that lead to conflict of interest and misaligned profit-share along the supply chain (Sousa-Zomer et al., 2018; Tura et al., 2019a; Whalen et al., 2018). Losing contact to the end-customer when moving up the supply chain is a known issue in the servitization literature (Finne and Holmström, 2013). This is due to the rise of system integrators, which restrains them from proper servitization, and is a barrier to increasing stewardship observed in the presented study. PumpCo faces challenges to servitize due to changes in the customer structure and the service-ecosystem they are part of. In the oil, gas, and chemical industry, the largest markets for their products, their customers increasingly are turn-key engineering companies and no longer the owners and operators of the plants. This puts PumpCo further away from the end customer. These companies have a time horizon of 3-5 years, whereas the products will be in use for at least fifteen years. These intermediaries are predominantly interested in low capital cost, and not the resource consumption in the use phase, or the EoL of the products. By being further away from the end customer, the manufacturer loses transparency and knowledge

of what happens during the product use and at the EoL. The manufacturer tries to support the customer in the entire process of planning the CS, as servitization can as well help making sure that IP doesn't get too disseminated as products are at risk of reverse engineering.

Operational challenges regarding the infrastructure and supply chains could be predominantly observed in the case of CableCo. For their reusable cable reels, the company was lacking suitable infrastructure to develop closed-loop supply chain networks and a reverse logistics environment. The company need to establish new ways of customer engagement as customers turn into suppliers, a challenge identified previously by (Bressanelli et al., 2019; Sousa-Zomer et al., 2018). CableCo is affected by material loss (Yadav et al., 2020) due to the leakage to competition and recycling, raising concerns about consistency of flow of return goods (Guldmann and Huulgaard, 2020).

Interestingly, overall the return-flow-challenge (Bressanelli et al., 2019; Linder and Williander, 2017), is a widely recognized problem in the solution business and remanufacturing literature. It is evident that efficient product retrieval is a challenging aspect of remanufacturing. However, managing the predictability and reliability of the return flow has not been raised by the studied solution providers. Both companies that have remanufacturing operations, EVCo and PumpCo, mentioned that they have a good understanding what arrives when, for EVCo that is because of the take back agreement, and therefore they can make relatively reliable plans. EVCo and PumpCo have their remanufacturing operations in-house, with reduces the risk of mistakes by any third-party, a problem identified by (Bressanelli et al., 2019) which can have a negative impact on the manufacturer's brand image.

6.4.2.3 Technological

Technological barriers can stem both from within and external to the solution provider. In the presented study however, they are predominantly external and both normative and mimetic. The findings suggest that the technological barriers are at the means level and could be overcome if novel technological solutions were developed. EVCo's technological challenges arise from demands by the market, which asks for increasingly

complex products. For example, sensors and antennas have to become smaller and new material technologies are required, such as coating plastics with metal deposits, soldered connectors, and components that are increasingly built into the body and covered with lacquer. Further, the company is an industry leader in specialised durable cables in harsh environments. This creates engineering challenges to develop products that are both durable and recoverable. This challenge has been, for example, identified in the market of complex consumer goods (Tam et al., 2019), which are typically composed of multiple materials that are typically joined together via adhesive, welding, fasteners or other method with the intention for longer-term use, and possibly under adverse conditions, with high density of different materials, even in small products (Guldmann and Huulgaard, 2020). Product mass customisation, which leads to a higher complexity (Bressanelli et al., 2019) of products, often makes reuse and remanufacturing of these customised products challenging. This study expands the examples of product complexity as a barrier to stewardship practice with an example from a CS.

The proliferation of new materials, as well as the growth of product complexity, increases the difficulties in managing recovering and recycle processes. For example, the number of new polymers has continued to grow in the past decades, increasing exponentially the material complexity and the difficulties in plastics recovering and recycling. This also means that the total amount of distinctive materials decreases (Bressanelli et al., 2019). For CableCo, however, the design of the cable reels resulted in the use of traditional polymers because no green polymers would deliver the durability required, a problem identified by (Paletta et al., 2019) who found that lack of mechanical performance in recycled plastic-based products is a barrier. The existing literature identified the contamination and technical insufficiency of recycled plastics (Leissner and Ryan-Fogarty, 2019; Paletta et al., 2019) as a barrier. This study expands the findings with the case of CableCo, who reported that certain material challenges hinder them from increasing their stewardship, as pristine resources are required to ensure the product's functionality. For example, the amount of recycled material cannot exceed a certain amount in some cables as the signal quality would be compromised, or the cable reels would not be strong enough. In some cases, extending the resource lifetime is not

possible, because of the need to ensure more important product attributes, such as safety of the vehicles. Safety must not be compromised. This may hinder the adoption of stewardship practice further.

Rebound effects

An often-discussed issue in the literature on sustainable CS are rebound effects which happen when eco-efficiency strategies at a micro level lead to increased resource consumption at a macro level. One of such rebound effects are products that are designed to last would be unable to participate in the continuous technology improvements processes (Bressanelli et al., 2019). PumpCo's products are oftentimes used for decades, but prolonging the lifespan of energy or consumable intensive products leads to losing the chance of participating in the continuous efficiency gains in energy consumption offered by new technologies, and taking advantage of more material-efficient eco-design (Frishammar and Parida, 2019). The lack of knowledge about the wider implications of servitization and its potential environmental negative outcomes indicates a lack of professionalisation as well as a lack of best practices.

6.4.2.4 Regulatory

Coercive pressures are in many studies identified as a significant driver towards sustainability. The lack of supporting standards and laws, however, can pose a threat towards increasing sustainability in CS. Even though studies have found that stronger legislation, for example, may not increase the disclosure of CE practices (Dagiliene et al., 2020), the majority of authors agrees that the lack in suitable regulations is a major barrier towards CE (Caldera et al., 2019; Choudhary et al., 2022; Do et al., 2022; Ranta et al., 2018b). The regulatory barriers are at the goals level, as for most identified regulatory barriers solutions would exist but they are not pressing enough to be implemented and are therefore fundamental.

Standards

The extant literature discusses different regulatory transformation barriers for increasing stewardship practice. Companies are lacking, for example, standards and regulations for

circularity (Bressanelli et al., 2019) with negative impact taxation systems (Veleva and Bodkin, 2018). Some of these issues could be identified in the study presented, however were not reported as major barriers. The main barrier identified, in particular by PumpCo, but as well in the case of CableCo, is the role of industry standards. The major industries PumpCo operates in are oil, gas and chemicals which have set standards and are highly regulated in the specifications of products and leave little room to develop new CS. Because of the strict industry regulation, it is almost prescribed how many of the components have to look and perform. This leaves little freedom in designing for circularity. The industry makes the norms, and they are predominantly interested in profit and safety. Those priorities may be conflicting with stewardship. As long as the industry standards, developed by the customers give design freedom, and require stewardship practice, the solution providers hands are bound.

Law

Tura et al. (2019a) has identified that region-specific laws and regulations may play against sustainable CS and stewardship practice. It is particularly difficult for smaller companies such as EVCo to maintain current knowledge of the policy and laws for the use of vehicles up to date, as they are different in every country. For example, when returning and transporting products they may not be labelled waste, otherwise they are not allowed to be imported. Other regulatory challenges include the use of data. Each country of EVCo's customers has their own regulation on monitoring their employees and storing data, which makes the full use of a fleet management system challenging as the full potential of the software may not be used. Further, in some countries there were disputes with the workers' unions against both increasing efficiency and monitoring their employees (Guldmann and Huulgaard, 2020; Masi et al., 2018) found that circularity is not effectively integrated in innovation policies and that there is often a lack of government support in the form of suitable legislation.

Hindering legislation, in the case of EVCo, is for example that the remanufactured vehicles run at 45km/h, whereas many private customers want one with a maximum speed of 30km/h. This is because otherwise they would need a motorcycle licence and require

wearing a helmet. This poses a barrier to widely using 2nd life vehicles. That becomes a major reason to buy new vehicles with private customer specification instead of a remanufactured, professional vehicle. It would be easily solvable technically to cap the speed, but the regulation doesn't allow that to happen. Once a vehicle is first registered, it can't be changed/choked afterwards. If the vehicle is built on a new chassis and it gets a new chassis number, it would be possible but not with the existing chassis number. Other examples include the reuse of parts from harvested vehicles, which cannot be built into new vehicles.

6.5 Drivers of Change in Logics

The findings of the study revealed that the success of sustainable value propositions in CS is internally and externally influenced by institutional drivers. Studies in the field of CE and Institutional Theory have previously used the terminology of institutional drivers (Calzolari et al., 2021; Ranta et al., 2018b). The present study expands this notion and differentiates by enablers, certain prerequisites, and accelerated through catalysing factors. Similarly to the findings of the presented study, Schrettle et al. (2014) previously identified that sustainability drivers are both endogenous (internal) and exogenous (external) and identified strategy, culture and resource base as internal, and environmental regulation, societal values and norms as external drivers, respectively.

As discussed in Section 6.3.3, institutional drivers for CE can be driven by both efficiency and legitimacy. The subsequent discussion of institutional drivers strengthens this argument. These isomorphic drivers are presented in Table 6-1. Although there is no definitive answer to which drivers are motivated by efficiency or legitimacy, it can be observed that the regulative drivers are predominantly driven by legitimacy, while the cultural-cognitive drivers are predominantly driven by efficiency. The normative drivers are equally distributed as driven by efficiency and legitimacy.

Table 6-1: Isomorphic drivers

Institutional pillar		Driver	Reference/New
Regulative Coercive pressures which are legally governed (e.g., rules, laws, sanctions)	<i>External Enabler</i>	Legislation supporting sustainability	Caldera et al. (2019), Calzolari et al. (2021), Do et al. (2022), Ranta et al. (2018b), Stål & Corvellec (2018)
		WTO tenders allow smaller companies to bid	No reference identified
Normative Normative pressures which are morally governed (e.g., certification, accreditation)	<i>Internal Enabler</i>	Supplier audits	Dubey et al. (2018)
	<i>Internal Catalysts</i>	ISO Certification and a role model function as a company act as an amplifier in the service-ecosystem	Stål & Corvellec (2018), Dagiliene et al. (2020)
		Employees that are interested in sustainability are intrinsically driven to work for the company and need less supervision	No reference identified
		Start at some point to start learning	Choudhary et al. (2022)
	<i>External Enabler</i>	Take back scheme for all vehicles from all customers	Calzolari et al. (2021)
		Sustainability becomes a hygiene factor/order qualifier	No reference identified
		Certification helps to evidence sustainability in the tendering process	Stål & Corvellec (2018), Dagiliene et al. (2020)
Cultural-cognitive Mimetic pressures from peers (e.g., shared best practice)	<i>External Catalysts</i>	Products are widely used in public. That conveys a message that sustainability is possible	Calzolari et al. (2021)
	<i>Internal Enabler</i>	The demands of one customer can increase the sustainability of an entire service ecosystem	Calzolari et al. (2021)
		Differing needs in different markets are a driver for the business case for remanufacturing	Dubey et al. (2018)
			Ranta et al. (2018b)
	<i>Internal Enabler</i>	Financial independence	Ranta et al. (2018b)
		Proximity within the organisation	No reference identified
		Flat rate maintenance contracts	No reference identified
	<i>Internal Catalysts</i>	Predictability of vehicle returns from customers	No reference identified
		Technology and processes for predictive maintenance and reduction of pollution	Calzolari et al. (2021)
	<i>External Catalyst</i>	Increased exchange with suppliers helps to solve problems quicker	Dubey et al. (2018)
		The innovation of processes is made publicly available to increase the impact on the companies concerns	Choudhary et al. (2022).

6.5.1 Coercive Drivers

Coercive pressures were previously identified as one of the main drivers and influence the adaption of CE the most (Caldera et al., 2019), due to increasingly strict environmental laws (Do et al., 2022). The research presented confirms previous research (Ranta et al., 2018b) that suggests, that the coercive pressures are regionally different, which in the presented case poses a challenge as components are sourced from China, whereas the majority of customers are European and fall under stricter European and national laws (Calzolari et al., 2021; Ranta et al., 2018b; Stål and Corvellec, 2018). The study identified that legislation is a strong supporting enabler for sustainability in companies. This finding is in line with Reim et al. (2015) who found that legal and market conditions can be important motivators for companies to endeavour to use the full potential of the CS offering in terms of sustainability.

Previous research has identified that coercive pressures have a significant beneficial influence on environmental performance (Jain et al., 2020) and top management commitment (Dubey et al., 2018), two findings that the presented findings do not support nor refute. The lack of influence on top management commitment can potentially be explained because the case company is a company practising stewardship actively and in many cases is ahead of the environmental regulations. The study found that an important external enabler to CE is the public procurement criteria, which via the World Trade Organisation requires large companies to have open bids and follow certain criteria. This is an institutional driver that was previously not identified in the literature.

6.5.2 Normative Drivers

Previous studies have identified normative pressures as an important driver towards CE because they are driving the incorporation of new internal rules and legitimate new internal practices (Caldera et al., 2019). In the context of CS and CE the normative pressures are particularly important because they govern the practices within service-ecosystems and the activities between companies. In the presented study, a major internal enabler for CE is that the company audits their suppliers themselves to ensure that the

expected stewardship practices in the upstream supply chain are complied with. The influence of normative pressures on supplier's top management has been investigated previously (Dubey et al., 2018). That study however found that there is no significant relationship between CE and top management commitment, a finding that cannot be supported or refuted by the present study. The previous study, however, was conducted with companies in India and China, and it is likely that in another geographic region the normative pressures on suppliers are higher.

The study identified four internal institutional catalyst which accelerated the adoption of CE in the CS. Normative pressures are relevant for a business environment because they influence the professionalisation within an industry, and previous studies have found that normative isomorphism positively shapes the development of environmental reporting from the CE perspective (Dagiliene et al., 2020). The relevance of professionalisation of CE has been highlighted by Stål & Corvellec (2018). As a result, there is a lack of clarity in what CE practices are legitimate, and when companies only adopt symbolic practices but remain mainly linear. This finding is supported by (Jain et al., 2020) who found that NP do not have direct or indirect effect on CE performance and, therefore, could be 'symbolic' rather than 'substantive', a finding which the present study cannot support.

The findings of the study found that employees that are interested in sustainability are intrinsically driven to work for the company and require less supervision. Interestingly, no previous research could be identified that investigated employee interest in sustainability. The lack of employee related research in CE and Institutional Theory is in particular interesting, as corporate legitimacy is regarded as critical to the survival of corporations because it is a precondition for the continuous flow of and access to resources such as skilled workforces (Deephouse et al., 2017).

The findings of the study suggest that it is important to start practising stewardship small, and then learn. Companies must start at some point to improve. Once started, it is important that employees are trained and encouraged to better understand the benefits for the customer of a CS. Longoni et al. (2014) found that sustainability is often implemented through top-down action programs, especially in the early stages of adoption, whereas the

presented study paints a picture of employees that are already interested in sustainability and do not need much convincing. Similarly, Marić and Opazo-Basáez (2019) found that voluntary pro-environmentalist attitudes toward product returns, rather than solely commercial gains or legislation-imposed pressures, facilitate closed-loop supply chains model development. This is an issue highly relevant to the case presented. The importance of ‘starting somewhere’ is particular important because it requires leadership commitment which is only salient in certain companies, but identified to be a main driver for environmental sustainability (Choudhary et al., 2022), and given the ownership structure of the case company, this can be confirmed.

As a fourth internal enabler, the case company has a voluntary take back scheme for all vehicles from all customers. From an institutionalist perspective, this is interesting because the company doesn’t have good margins on the remanufactured goods and does it because it is ‘the right thing to do’. It is done to reduce the environmental footprint and reduce external costs to society (Calzolari et al., 2021). Calzolari et al. (2021) found that companies engage in CE to become a promoter for a systemic change of the economic paradigm, a finding that the present study supports. They however do not discuss the motivation behind the adoption of these practices, which leaves it open to interpretation if companies engage in CE for intrinsic or mere symbolic purposes.

As a key prerequisite for the success of sustainable CS, the study identified that sustainability must be a qualifier in the customers’ procurement process. Hallstedt et al. (2020) argue that only when the customers clearly articulate needs for more sustainable CS for their operations, does the focus of the SME manufacturers shift towards more sustainable CS. Reim et al (2015) further suggests that customers may favour CS with a higher sustainability focus, because they are likely to represent greater value to the customers' business operations. Interestingly, customer requirements for CE have not been widely discussed in previous studies using Institutional Theory. Because for some companies being sustainable is a main requirement for their suppliers, sustainability certification increasingly becomes not only a ‘nice to have’, but a central requirement (Dagiliene et al., 2020).

Schrettle et al. (2014) argue that a substantial benefit of sustainability initiatives is generated if consumers reward the efforts because of higher consumer preferences for sustainable products or supply chains. The case company's vehicles are widely used in public by their customers and convey a message that sustainability is important to them and create transparency and awareness of the posts' ability to communicate with the market. Calzolari et al. (2021) found that organisations want to be at the forefront of a systemic change of the economic paradigm that is more sustainable, and the presented study suggests how a manufacturer in a CS can offer exactly this and show it to the society at large.

With respect to making entire service-ecosystems more sustainable, the study identified that the demands of one customer can increase the sustainability of an entire service-ecosystem if they allocate resources to change their suppliers' practices. Although studies found that normative pressures are not significantly important to suppliers (Dubey et al., 2018), the presented study suggests that the market pull is one of the most important drivers towards sustainability as customers want to reduce their environmental footprint, uncertainties, and risks while investing in a future for green growth (Calzolari et al., 2021). The last external catalyst towards sustainability is that different institutional environments allow manufacturers to essentially remarket used or remanufactured products into different markets, in which the notion of 'new is always better' may not apply. Ranta et al. (2018b) found in their comparative study that, for example in China, the products hold ViU for a longer period of time, supporting reuse. The presented case supports the notion that re-marketing into markets with other institutional norms can be a driver for sustainability.

6.5.3 Mimetic Drivers

While coercive and normative isomorphism mainly is characterised by organisations gaining legitimacy, mimetic isomorphism is predominantly driven by efficiency gains and reducing uncertainty by mimicking best practices (Do et al., 2022; Jain et al., 2020). Within the field of CE, the imitation of and adaption of best practices from successful competitors (Caldera et al., 2019) has been found to be a significant driver for increasing

top management commitment from suppliers (Dubey et al., 2018), and to positively shape the development of environmental reporting from the CE perspective. Probably the single most important driver towards sustainability for the case company is its financial independence, as the company is founder owned and led. Because of that independence, the owner is not accountable towards any other shareholders and can decide how much he wants to invest into the development of sustainable CS. Extant research has previously identified that servitization leads to upfront cost for the provider and their suppliers (Lockett et al., 2011), as well as additional ‘transition’ investments to create the system that produces the CS (Tukker, 2004). This finding supports previous reporting by Ranta et al. (2018b) who argue that the owners privately held, as opposed to publicly traded, companies are likely to initiate and foster CE in their companies and acknowledge resource scarcity and the need to use materials more efficiently.

The practices by which organisations successfully develop and market products and services are idiosyncratic to each company and differ by geographic regions (Ranta et al., 2018b). Calzolari et al. (2021) found that mimetic pressures influence how companies follow best practices to identify market gaps, innovate and try to achieve competitive advantage, use regenerative resources, and avoid wasting valuable resources. The internal enablers for the case company, that is to say, the relevant practices that help them develop and maintain successful CS, is the physical proximity within the organisation and communication among the teams, flat-rate contracts which allow the company to reuse harvested parts, and long contracts which ensure the predictability of vehicle returns from customers. Previous research has not identified these mimetic best practices from an institutional perspective.

Avoiding wasting valuable resource is a major mimetic pressure towards CE (Calzolari et al., 2021). Novel technologies and processes such as predictive maintenance, or in the presented case fleet management solutions, are of great importance to accelerate the implementation and adoption of sustainable CS. To succeed, companies required dynamic capabilities which offer a good ground to facilitate sustaining success in a fast, technologically changing environment (Eloranta and Turunen, 2015), intelligence capabilities to configure hardware component to sense and capture information with low

human intervention and have assets connected through wireless technology (Lenka et al., 2017). The servitizing companies, according to Lenka et al. (2017) and Opresnik and Taisch (2015) require significant analytic capability to process the huge amounts of data produced by the intelligent products and networks. Servitization and the exploitation big data strategy do not exclude each other, but conversely they do reinforce each other. The more a manufacturing enterprise servitizes its products, the more users they have, the more data can be collected and information exploited through resell and/or reuse (Opresnik and Taisch, 2015).

As an external mimetic catalyst, the innovation within and outside of the service ecosystem is of great importance. The finding of the study suggests that an increase in exchange with the supplier helps to solve problems and implement CS quicker. Increased coordination with suppliers to integrate them in the CS (Ng and Nudurupati, 2010) has been previously investigated and found that having a shared culture and common values between partner stakeholders in closed-loop supply chains leads to efficient reverse logistics services (Marić and Opazo-Basáez, 2019), and reduce the information asymmetry and increase the information exchange and the nature and quality of relationship (Lockett et al., 2011). Martinez et al. (2010) further suggest that a greater degree of cooperation between a provider and its supporting network is required as a different degree of insight into the problems and applications of customers is necessary, but information and knowhow sharing upstream is more complicated than downstream. Further, the case company makes the innovation of battery recycling processes publicly available to copy and increase the impact on the companies' concerns. The case showcases the importance of top management commitment to supplier engagement (Dubey et al., 2018) and supports previous studies that reported positive impact of eco-innovation behaviour on environmental performance (Choudhary et al., 2022).

6.6 Synthesis of the Findings

The study, based on literature and two empirical case studies investigated sustainable RI practices in CS. In doing so, the study identified a cyclical mechanism, embedded in the service-ecosystem which consists of five elements in Figure 6-1. At the heart of creating value in a sustainable CS lies the premise that economic, environmental, and social goals can be achieved by the customer. The presented study used the sustainable PL, identified through stewardship practice, which is predominantly aimed at achieving environmental goals, and the service ML, which is predominantly aimed at achieving economic goals.

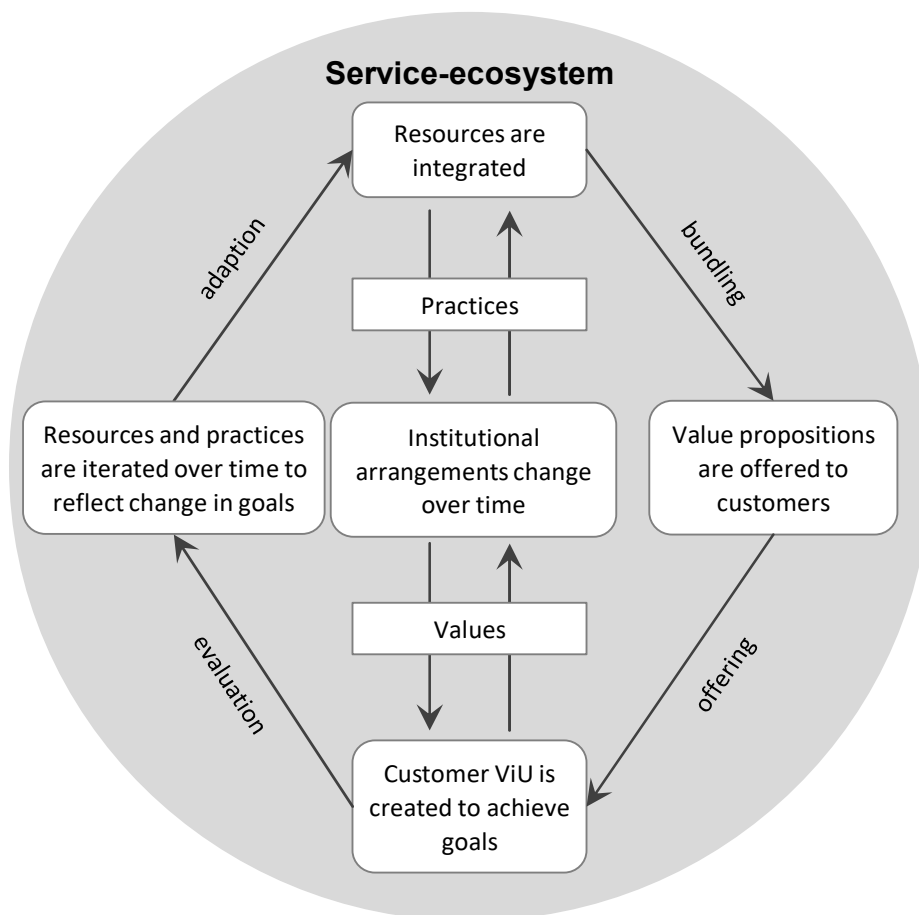


Figure 6-1: Value creation cycle in sustainable customer solutions

The presented study suggests that CE exists as an institutional logic, an institutional arrangement that changes over time, and manifests and coordinates goal setting and RI practice in service ecosystems. A CE logic is a hybrid of a pure economically driven and pure environmentally driven business logic with the aim to create sustainable value. Complying with this CE logic is a source of legitimacy and salient actors, such as the company presented in the single-case study, drive the institutional change in the service ecosystem.

A sustainable PL, identified through stewardship practice in the RI practice, could be identified in both case studies. In the multiple-case study, in all the cases the companies showed examples of a sustainable PL. However, only one initiated the sustainable PL proactively and therefore practices stewardship, while for the other two companies, the sustainable PL was a result of changing towards a service ML. The single-case study confirmed suggestions from the literature, that operant resources work on operand resources in the RI practice. These operant resources have different roles to enable, facilitate, and drive the stewardship practice of the operand resources.

Not surprisingly, the most important resource aspects of environmental value happen in the operand resources, as those are the material components of the CS that have an ecological impact. In the single-case study, the findings suggest that the operant integrated resources lead to more than one value proposition component and therefore lead to the achievement of multiple goals by the customer. Practising stewardship is an intentional, proactive process in the decision-making to reduce non-renewable resource consumption, extend resource life, and reduce leakage of resources as waste. The study suggests using principles which are collected under the umbrella of CE to identify and practise stewardship. RI practice from an institutional perspective takes place at a field level which in the empirical context is the service ecosystem.

The solution providers' value propositions are a combination of multiple components that can be adjusted to the customer's needs and are tailored to each new customer. This is characteristic of CS. The solution provider creates potential value and communicates it in value proposition to their customers, which they then realise. In this process, the value

propositions are the linking element between different levels in the service ecosystem, the solution provider's resources and the customers' value creation, as established by the use of means-end chain analysis in the single-case study.

Companies have economic, environmental, and social goals that are competing for attention and resources to achieve them. The findings of the study suggest that the three dimensions of goals are hierarchical, with economic goal achievement being the most crucial. Customers of sustainable CS will expect that the CS allow them to achieve multiple goals. The goals are achieved by creating ViU through the RI in the service ecosystem, with multiple ViU constructs leading to the achievement of a goal.

A customers goals, and therefore the ViU they seek from solution providers, change through both internal and external changes within their stakeholders and institutional arrangements. The change in goals creates a push to develop the solution further, and leads to changes in the resources integrated and consequentially to the Value proposition components communicated. The resources and value propositions are continuously added, removed, or changed over time and adjusted to the changing customer requirements.

The value creation cycle (Figure 6-1) of sustainable customer solutions encompasses critical phases of bundling, offering, evaluation, and adaptation. Throughout this cycle, the study identifies a range of internal and external challenges and drivers that dynamically influence the development and implementation of sustainable solutions. Interestingly, an analysis of these challenges and drivers reveals their interconnected nature, illustrating the complex interplay between internal capabilities, external ecosystem partners, and market demands. A detailed record of the occurrences from the findings on barriers (Section 6.4) and drivers (Section 6.5) is given in Appendix D

During the bundling phase, the solution provider is tasked with integrating necessary resources into a marketable value proposition for customers. Internally, this phase highlights the significance of specific capabilities, such as design for remanufacturing and knowledge of predictive maintenance technologies, in ensuring the sustainability of the solutions. Moreover, the intrinsic motivation of employees towards sustainability

proves advantageous, as it fosters the proactive pursuit of sustainable solutions. Externally, the successful establishment of sustainable customer solutions relies on ecosystem partners' readiness to embrace stewardship practices in resource integration. Demonstrating sustainability through certifications and adherence to industry norms strengthens the tendering and procurement process. Nevertheless, challenges arise for smaller companies that lack the resources for extensive research and development of innovative materials and technical solutions, making stewardship implementation at this phase particularly daunting.

In the offering phase, the solution provider proposes the value proposition to customers, necessitating ambidexterity in providing a diverse array of solutions with varying degrees of sustainability. Consolidating and standardizing parts of the offering proves beneficial in enhancing sustainability efforts. External factors significantly impact the success of sustainable solution businesses, with sustainability increasingly serving as a hygiene factor and order qualifier for customers. Favourable legislation supporting sustainability and a positive trend towards incorporating sustainability aspects in tenders also drive the acceptance of smaller companies with innovative sustainable solutions. Nevertheless, some markets present challenges in convincing customers of sustainable solutions, particularly when awareness of sustainability is low, or fashion vulnerability and data concerns are present.

In the evaluation phase, customers assess the value created by the solution and identify necessary changes. Several drivers increase the likelihood of customer acceptance towards sustainable solutions, including flat-rate maintenance contracts and differing market needs driving the business case for remanufacturing. Additionally, the demands of one customer can significantly impact the sustainability of an entire service ecosystem. ISO certification and role model functions play pivotal roles in amplifying sustainability efforts within the service ecosystem. The alignment of organizational cultures between solution providers and customers is crucial at this phase to ensure that necessary changes are effectively implemented.

The adaption phase entails adjusting the resource integration in the service ecosystem to align with the customer's changing goals. Various internal drivers accelerate the pace and quality of these adjustments, including the solution provider's agility, internal proximity, and breaking down silos between departments. Financial independence and liquidity prove vital in this phase, enabling longer-term investments and operational improvements. Improved predictability of asset returns and increased exchange with suppliers facilitate quicker problem-solving and adherence to agreed stewardship practices. However, the major challenges at this phase stem externally from regulations and laws, which may hinder the integration of technically suitable means to achieve optimal customer solutions.

The presented framework builds on and contributes to multiple existing frameworks. Four studies, by Kleinaltenkamp et al. (2012), Macdonald et al. (2016), Payne et al. (2020), and Storbacka et al. (2016) as portrayed in Table 6-2, are closest related to this research. Collectively these frameworks present a view of value creation in solution business that support the framework presented. None of them gives all of the components in Figure 6-1 justice and only the framework by Macdonald et al. (2016) was derived from empirical data. In that sense, the presented framework synthesises extant work and validates the conceptual work empirically.

Table 6-2: Existing frameworks

Autor	Based on	Focus	Key message of the research	Difference of the presented framework
Kleinaltenkamp et al. (2012)	Conceptual	Taking stock of the idea of resource integration and presenting a research agenda	Based on service-dominant logic, a conceptual framework is presented that describes the resource integrators as actors, the resources involved, the resource integration practice, value created and its evaluation.	The framework acknowledges that value and its evaluation is phenomenologically determined but does not describe the social context of how value is created.
Macdonald et al. (2016)	Empirical data	Empirically derived to understand how customers assess the quality of solution business and how value-in-use is created through joint resource integration	Value propositions are co-created between the customer and solution provider. The quality of a solution does not just derive from the resources provided by a solution provider. It is also dependent on the relationship between the two and the customers resources. Value-in-use is both at the individual and collective level.	The framework considers value propositions and how they are co-created, but not how they are used as a means to communicate value to customers. It does recognise that value for different actors at an individual and collective level differs but an explicit explanation of the contextual factors for resource integration practice and value creation is lacking.
Payne et al. (2020)	Existing frameworks	Strategy and implementation of value propositions	Companies need to create a fit between their business models and their value propositions by engaging customers as collaborators, co-creators, and sources of competence. Value propositions need to be designed and value needs to be quantified, communicated, documented, and verified.	The framework highlights that value proposition design is an iterative process and that value is contextually dependent and at an interface with other actors. The framework focuses on the value proposition and the value for the customer and lacks in considering the resource integration aspect and practices of value creation.
Storbacka et al. (2016)	Conceptual	Promoting the link between the institutional logics of a service ecosystems at the macro and the resource integration practice at the micro level	Research in value co-creation is difficult to observe empirically, whereas practices are observable, therefore easier to manage. Actors are not only humans but as well technology.	The framework establishes the link between macro level value creation and micro level practices. It does not sufficiently establish the iterative nature of value creation and constant appraisal of value and change of resources to be integrated.

Section 1.2 presented a research problem begs for additional understanding, identifies the need for choosing between alternative courses of action, and leads to undesirable consequences. The purpose of this inquiry was to resolve the research problem by accumulating sufficient knowledge which it has done successfully. To conclude the discussion, the overarching research question “How does resource integration in sustainable customer solutions lead to customer value? “ can be answered. Customer solutions are sustainable when they allow the customers to simultaneously achieve economic, social, and environmental goals through the creation of customer ViU. Goals are dynamic, and incorporating sustainable development in goal setting and the production logics may lead to tensions and trade-offs that influence the ViU creation a company is seeking.

Environmental sustainability in CS is the result of stewardship practice in the RI, which ideally is intentional, but can as well be an unintentional, beneficial spillover effect of changing from a product to a service ML. Stewardship is practised by following certain principles at a micro level of RI in the decision-making process. Solution providers communicate their ability to facilitate the customers' value creation through value propositions. These are combinations of benefits derived from the various integrated resources and they communicate to the customer potential for ViU. Resources, practices, and value proposition components are continually added, removed, or changed throughout a solutions contract to adapt and to resolve barriers caused by complexity, to achieve customers' multiple goals. In recent years, the idea of a CE, a hybrid logic that coordinates goal setting and RI on a field level, has been the focus of achieving both environmental and economic values simultaneously.

7 CONCLUSIONS

7.1 Research Summary

This research was conducted to better understand resource integration (RI) and value creation in sustainable customer solutions (CS). Actors at a micro level are constantly integrating and exchanging resources from varying contexts (Chandler and Vargo, 2011). The study used stewardship practice in the RI to identify the decisions based on their socially constructed macro environment (Kohtamäki and Rajala, 2016; Suddaby et al., 2013). The examination set out to substantiate the conceptualisation of multiple logics within the servitizing manufacturer (multiple-case study in Chapter 4) and how compatible service ML and sustainable PL lead to sustainable value propositions (single-case study in Chapter 5). The primary data for this study has been obtained from 43 semi-structured interviews with three companies and four sustainability experts which were conducted in 2019 and supplemented with secondary data, such as the companies' annual reports and internal guidelines.

To explore how RI in CS is sustainable, the multiple-case study has been carried out based on the data from 30 interviews from three companies. The study identified practices, values, and beliefs for the ideal types of traditional and sustainable PL, as well as product and service ML. Based on these ideal types, occurrences were identified in which the service ML is conflicting, competing, and compatible with the sustainable PL.

Four occurrences were identified in which the two logics are conflicting. These are that there is no internal interest and consideration of sustainability on the provider side, that there is no customer interest in advanced services and sustainability, that there are laws and regulations restricting the stewardship practice, and that there is a lack of sustainable technologies and markets for EoL resources. The main occurrence where the sustainable PL and the service ML are competing is when solution providers must make a trade-off between better financial performance and uptime with reducing resource consumption in the different life cycle stages. The two occurrences in which the logics are compatible are

when stewardship is practised proactively by the solution provider and/or sustainable, resource efficient, solutions were demanded by the customers.

The multiple-case study found that CS can increase stewardship practice, both intentionally and unintentionally, and suggests however that for true sustainability, stewardship practice must be practised consciously and intentionally so that the environmental benefits are not a mere spillover of economically driven decisions. The study suggests that manufacturers who servitize are not categorically sustainable and pure types of sustainable companies do not exist. All companies blend multiple PL and ML at the same time. This must be navigated collaboratively between the solution provider and the customers to create conditions in which CS are sustainable. Some aspects of the solution will be sustainable, some will be challenging to be sustainable. The study identified barriers to practise stewardship and found that they exist internally and externally and can be both technical and cultural.

Out of the three cases in the multiple-case study, the most sustainable of the three cases was chosen to carry out an in-depth case study to explore how the RI in the solution translates into value for the customer. The data for this study has been obtained from 23 interviews with the solution provider, their customers, and additional experts. The analysis identified six operand and six operant resources, 14 Value proposition components, and eight ViU constructs were identified and used for the means-end chain analysis, resulting in 83 means-end chains. The findings further confirmed what the available literature suggests: that operant work on operand resources.

Value proposition development can be triggered internally or through the customer and is done for every customer with the operant working on the operand resources at the different life cycle stages. The analysis identified 14 Value proposition components of which however only three account for half of the mentioned ViU constructs. Eight ViU constructs were identified that allow the customer to achieve economic, environmental, and social goals. Weighted in terms of mentioning, the ViU constructs for achieving economic goals outweigh the other two and account for around half of the means-end chains, indicating that the change to a service ML is predominantly driven by an economic

business rationale. The study suggests that customers' goals and the assessment thereof are continuously changing. This changes the ViU they are seeking, requiring the value proposition to be dynamic and continuously changing, which is realised through the adding and removal of the integrated resources. Further, the study identified a set of internal and external enablers and catalysts for sustainable solution businesses, some of which could were not previously discussed in the literature.

Based on the synthesis of the two studies, the main research question could be answered, and the findings were presented in a framework to visualise the relationship between the individual findings. The framework describes the value creation with a temporal dimension, making it a dynamic process with evolving value propositions that act as linking elements between the RI at the micro level and value creation at a macro level, through an evolving circle. The value propositions are a combination of benefits derived from the various integrated resources and communicate to the customer potential for ViU which customers seek to achieve their goals. Incorporating sustainable development in goal setting leads to tensions and trade-offs that influence the ViU creation a company is seeking. To ensure environmental sustainability, stewardship must be practised at a micro level of RI in the decision-making process. The resources, practices, and value proposition components are continually added, removed, or changed throughout a solution's contract to adapt to resolve barriers caused by plurality in the institutional logics to achieve customers' multiple goals. The presented framework builds on and contributes to existing frameworks such as the ones presented by Kleinaltenkamp et al. (2012), Macdonald et al. (2016), Payne et al. (2020), and Storbacka et al. (2016).

The following sections in this chapter conclude the research by outlining the major contributions and limitations of this research. Table 7-1 provides an overview of the main contributions. Section 7.2 commences by presenting the contributions to the theory and academic practice. Section 7.3 outlines the suggested contributions to management practice. Section 7.4 presents the limitations and their implications for the research and its findings as well as the potential future research areas.

Table 7-1: Contribution

Theoretical contributions	Why is it relevant	Relevant extant literature
<p>Institutional arrangements manifest at multiple levels in the service ecosystem. Logics can be conflicting, competing, and compatible within the ecosystem.</p>	<ul style="list-style-type: none"> • Social interactions and inter-subjective research approaches are key to understanding the dynamics of sustainability within institutional arrangements. • Ideal types facilitate the identification of conflicting, competing, and compatible logics, unveiling the synergies, tensions, and trade-offs that arise from pursuing different sustainability and resource consumption goals. They offer valuable insights into the complexities of balancing diverse logics and practices in the context of sustainability and resource management. 	<ul style="list-style-type: none"> • Greenwood et al. (2011) present a comprehensive review of how organizations respond to institutional complexity, situations where organizations experience a multiplexity of different pressures from a plurality of institutional logics. • Frow et al. (2019) provide a conceptualization of service ecosystem well-being along micro, meso, and macro levels and how a shared worldview aligns institutionally embedded practices, supporting ecosystem resilience and successful emergence.
<p>Circular economy is a hybrid logic with field-level resource integration practice that manifests at multiple levels of aggregations in the service-ecosystem.</p>	<ul style="list-style-type: none"> • Institutionalization is important for industry-wide transformation and is induced by introducing clear definitions such as stewardship practice. The need for a balanced integration of social and natural sciences to achieve a sustainable paradigm change in CE is vital, as it has primarily been developed outside of academia. • The establishment of circular economy (CE) as an academic field by approaching it from a management theoretical perspective and supporting the concept of CE as a field-level hybrid logic aids in forming the field and enhances the understanding of CE within the management domain. 	<ul style="list-style-type: none"> • Blomsma and Brennan (2017) discuss the origin of CE and highlight the importance of a deeper understanding of the relationship between different resource life extending strategies in particular where different circular configurations of two or more strategies together work in sequence or in parallel • Korhonen et al. (2018a, 2018b) identified that there is discord between CE research published in natural science and social science, and that for a paradigm shift to occur, the different disciplines must come together.
<p>The value creation mechanism in solution businesses is interconnected between micro-activities, meso-configuration of service ecosystems, and macro-changes in the company's environment through means-end chains.</p>	<ul style="list-style-type: none"> • The dynamic means-end chain approach elucidates how the integration of different resources leads to sustainable value for achieving economic, environmental, and social goals, addressing the lack of definitions and blurred lines in extant research. • Understanding value in sustainable solution business other than directly observable units of analysis is important to understand the socially constructed nature of value. • By establishing a clear hierarchy of value, the study differentiates between value-in-use (ViU) constructs which are similar across companies and customers, and value propositions and resources, which are specific to each solution and ever-evolving. Value creation is an interconnected iterative cycle, not a linear end-to-end process and spans through all levels of aggregation in the service ecosystem. 	<ul style="list-style-type: none"> • Brodie et al. (2019) and Storbacka et al. (2016) discuss the value co-creation and challenges related to the intangible nature of value. • Woodruff (1997) described the hierarchy and linkage of value creation and integration of resources, Payne et al. (2020) more recently argued that value creation is a cycle and not a linear process.

Table 7-1: Contribution**Managerial implications**

Managers must integrate environmental sustainability objectives into their **resource integration practices** while adopting servitization as a business strategy.

- Incorporating stewardship practices and prolonging the lifetime of products through design considerations such as upgradability and repairability from the beginning and not as an afterthought will increase the likelihood of financial viability of sustainable customer solutions.
- Companies must start small by emphasizing circularity, resource efficiency, and considering the product's life cycle and continuously improving without cherry-picking. They must rigorously consider the entire life cycle of products and services, avoiding the label of Circular Economy (CE) for small incremental changes, and instead, focus on comprehensive sustainability efforts.
- Advancing services does not necessarily mean increasing sustainability and drivers for servitization are mainly economic. Shifting from a product to a service market logic can be compatible with sustainable production, but managers must proactively practise stewardship to ensure true sustainability and avoid merely using environmentally driven servitization efforts as a spillover.

The development of customer-centric **value propositions** is iterative and needs continuous adjustment of resources integrated.

- Managers must focus on developing customer-centric value propositions and continuously adapting their resource integration to meet changing customer demands, while incorporating stewardship practices to enhance their reputation and innovation with incremental steps towards sustainable customer solutions.
- Managers need to stay responsive to customer interests and expectations regarding sustainability, using the means-end chain approach to communicate how integrated resources contribute to achieving customer outcomes. Sustainability needs to be connected with key customer requirements to be a selling point, and managers must consider the relevance of addressing multiple stakeholders to achieve strategic goals and seek legitimacy.
- For larger companies, scalability and replicability of sustainable resource integration practices are critical considerations, and they must identify approaches that can be expanded across markets while maintaining environmental benefits.

- Bocken et al. (2014) and Evans et al. (2017).describe different sustainable business models and requirements for sustainable value creation.
- Kirchherr et al. (2017) emphasise the importance of distinguishing CE and sustainability and how this relates to strategy and practice.

- Jesus Pacheco et al. (2019, p. 916) suggests that the transition process towards sustainable product-service systems must be performed incrementally instead than radically
- Frow et al. (2014) and Payne et al. (2020) argue that value proposition development in solution business is not a linear but cyclical process.
- Nordin and Kowalkowski (2010), Reim et al. (2019), and Hallstedt et al. (2020) argue that for value creation in solution business to occur, the value has to be more than the sum of its individual resources integrated and must always allow for economic value creation.

Table 7-1: Contribution

Managers face different challenges that can be internal and external as well as means and ends.	<ul style="list-style-type: none"> • The challenges in servitization and circular economy differ fundamentally, with servitization aiming to move away from physical products while CE focuses on materials, and both require consideration of technical, managerial, and psychological/sociological aspects to enhance stewardship practices. • Managers must carefully assess internal (cultural, capabilities, ambidexterity) and external (market, service-ecosystem, technological, regulatory) factors that complicate servitization for circularity in their company's service ecosystems and proactively tackle these obstacles to increase the success of their sustainable solutions. The cause of these challenges can be at the goals or the operational means level. This categorization helps to better understand the importance of and prioritise challenges when developing sustainable customer solutions 	<ul style="list-style-type: none"> • Linder and Williander (2017) and Hopkinson et al. (2018) present studies that are concerned with the complexity of global circular economy business models and their inherent uncertainties. • In-depth single case studies were conducted by Sousa-Zomer et al. (2018) about implementation challenges of a pay-per-use service provider and by Yadav et al. (2020) supply chain challenges in a circular economy for an automotive manufacturer. • Masi et al. (2018), Caldera et al. (2019), and Guldmann and Huulgaard (2020) conducted multiple case studies about the implementation of sustainable business practice in manufacturing firms in a circular economy. • Ranta et al. (Ranta et al., 2018b) conducted a comparison barriers across the geographies of China, the US, and Europe.
Managers can rely on internal and external drivers for sustainable solution business that act as enablers and catalysts based on coercive, normative, and mimetic pressures.	<ul style="list-style-type: none"> • Understanding the difference between enablers that are key requirements and catalyst that accelerate the development of successful sustainable customer solutions as they help managers to prioritise which conditions they must provide to successfully develop the service-ecosystem. 	<ul style="list-style-type: none"> • Schrettle et al. (2014) identified that sustainability drivers are both internal (strategy, culture and resource base as internal) and external (environmental regulation, societal values and norms). • A number of authors have described internal and external regulative (Caldera et al., 2019; Calzolari et al., 2021; Do et al., 2022; Ranta et al., 2018b; Stål and Corvellec, 2018), normative (Calzolari et al., 2021; Choudhary et al., 2022; Dubey et al., 2018; Ranta et al., 2018a; Stål and Corvellec, 2018), and cultural-cognitive (Calzolari et al., 2021; Choudhary et al., 2022; Dubey et al., 2018; Ranta et al., 2018a) enablers and catalysts.

Table 7-1: Contribution

Policy recommendations	Why is it relevant
<p>Regulation must be less restricting for 2nd life applications and end of life scenarios.</p>	<ul style="list-style-type: none"> Restricting regulations can hinder the adaption of sustainable business practice in case they forbid reusing equipment in other than the initial market context. Therefore, policy should encourage the reuse of equipment and be flexible when it comes to reintroducing assets into secondary markets. Hopkinson et al. (2018) in their in-depth case study of an electronics manufacturer discuss the crucial role of policymakers as they have to remove barriers to remanufacturing and establish standards for remanufactured goods, particularly in the context of global trade. Kirchherr et al. (2018) present a large-N study on circular economy barriers in the EU and found that regulatory barriers are among the five most pressing barriers indicated by businesses and policymakers.
<p>Tax incentives for repairing and remanufacturing as well as the use of secondary resources need to be implemented to accelerate the transformation towards a circular economy.</p>	<ul style="list-style-type: none"> To promote repairing and remanufacturing practices, tax incentives should be introduced, especially in high-income countries where product replacement as opposed to repair is common. Lowering taxes on labour and imposing taxes on products made from virgin materials can make repaired and remanufactured equipment more competitive. Stricter laws should be implemented to regulate the use of non-renewable raw materials. Lower taxes on recycled and reused materials should be incentivized, while higher taxes on non-renewable virgin materials should discourage their consumption. By combining tax incentives and stricter regulations, a more sustainable and circular economy can be fostered, encouraging resource efficiency, and reducing waste. Stahel (2008) in his work on the Performance Economy and later Linder et al. (2017) identified fiscal reforms for the transition to a circular economy, particularly regarding reduced labour taxes and higher taxation for the use of raw materials, as important policy interventions that create incentives for remanufacturing Guldmann and Huulgaard (2020) observed regulatory barriers to be at the market and institutional level, as companies have no incentive in remanufacturing and recycling activities as they are expensive compared to the manufacturing of new products and virgin raw materials are too cheap and easier to manage in the manufacturing system because they have a more consistent quality and reliable supply.
<p>Sustainable innovation can be driven through public procurement.</p>	<ul style="list-style-type: none"> Aspects of sustainability must be implemented as non-negotiable criteria in public procurement, as governments play a major role in reaching carbon emission reduction targets. Guldmann and Huulgaard (2020) found that although economy-oriented public procurement policies could potentially alleviate the issue for companies with business-to-government sales, the majority of public procurement tenders focus on price as opposed to sustainability. Kirchherr et al. (2018) argue that financial support is already a commonly employed policy instrument in the EU and that publicly subsidising circular business models would make investing in circular business models more interesting, negating the excuse that circular economy business models are too expensive.
<ul style="list-style-type: none"> Governments and authorities must work closer with industry associations. 	<ul style="list-style-type: none"> Industries are oftentimes self-regulating and cohere to the rules and norms they impose on themselves through industry associations. These efforts, in particular on an international level, must be coordinated together with governments and authorities, so that regulation and norms are mutually reinforcing and not hindering. Caldera et al. (2019) recommend that policymakers develop schemes to facilitate SMEs to engage in business optimisation measures and establish industry support networks to connect SME industrial practitioners with technical experts to support lean and green implementation.

7.2 Theoretical Contributions

The emergence and institutionalisation of practices such as stewardship have the potential to change entire industries or even the economic system we all live in. How beliefs, norms, social roles, the meaning of value in its context, and the mode of behaviour change within an organisation, social system, or society, have been of perennial interest to the researchers of institutions (Kohtamäki and Rajala, 2016). The research presented herein offers three main contributions hitherto undisclosed within the scholarly discourse.

First, the presented study contributes to Institutional Theory by applying ideal types of market and production logics in empirical research (Marrewijk, 2004). It combines these ideal types with institutional pluralism and the theory of institutional complexity (Waeger and Weber, 2019) to discern conflicting, competing, and compatible logics. The academic interest in the phenomenon of competing institutional logics is evident in recent rise in empirical studies (Besharov and Smith, 2014; Dalpiaz et al., 2016; Pache and Santos, 2013; Santos and Pache, 2010; Smith and Tracey, 2016). This study aligns with this trend, advancing our understanding of the impact on organizations of this increasingly common phenomenon of conflicting institutional demands.

The amalgamation of ideal types for a sustainable solution business and institutional complexity represents a novel scholarly pursuit. It provides researchers with a unique methodological instrument to discern manifestations of complexity within institutional arrangements. The use of ideal types serves as a tool for generalizing theory through comparative analyses of change across a broader set of organizations. However, as noted by Waeger and Weber (2019), most organizations are not "pure types" and may instead blend types, highlighting the risk of reductionism that researchers must always consider.

The study employs ideal types and considers different practices within them, providing a practice theoretical approach (Suddaby et al., 2013). This approach helps understanding how actors at a micro level make decisions based on their socially constructed environment, allowing for an investigation into how institutions and organizations change, and observing the creation of blended types and the adaptation of new logics.

Change in institutions relates to research in Institutional Work (Lawrence et al., 2009) which is interested in how organisations align with their environment and reducing tensions or inconsistencies between the two.

The study found that tensions in the service ecosystem arise from achieving competing goals (i.e., growing business without consuming finite resources), competing logics within the service ecosystem (i.e., actors such as suppliers that are exposed to different logics), and incompatible practices (i.e., sustainable as opposed to traditional use of resources) (Pache and Santos, 2013). In the context of sustainable business, organizations increasingly adopt hybrid forms that integrate sometimes competing logics, such as practicing stewardship while creating economic value.

Service ecosystems for solution businesses are inherently fragmented fields, moderately centralized, and more likely to impose conflicting institutional demands on organizations than other fields (Pache and Santos, 2013). This is amplified by the globalization of practices and cultures, exposing organizations to the simultaneous influence of local and global institutional pressures. As the number of institutional influences on organizations increases, the likelihood of these pressures conflicting also rises. Understanding these mechanisms of competing demands is important because sustainability-related activities are oftentimes opaque and at risk of institutional decoupling (Wijen, 2014).

The study is in line with Frow et al. (2019), Pop et al. (2018), and Koskela-Huotari et al. (2016) and confirms that institutions and institutional arrangements manifest at multiple levels of aggregations in the service-ecosystem. Lieder and Rashid (2016) argue that the change towards a CE happens in the nexus between the social context at a macro level and the activities at a micro level. The study has identified manifestations of this change at the level of resource integration practice, value propositions and goal achievement.

The social context includes that markets emerge through the social interaction of actors in a social context that is exposed to institutional arrangements which is confirmed through the inter-subjective research approach (Löbner, 2011).

Frow et al. (2019) articulate a conceptual framework for the well-being of service ecosystems. The augmentation of well-being extends across micro, meso, and macro

levels, facilitated by a shared worldview that enhances the efficiency and efficacy of resource integration. Additionally, it involves heightened resource density and the adoption of common resource integrating practices, institutionally structured to govern interactions throughout all strata of the ecosystem.

A service ecosystem perspective proves instrumental in elucidating intricate market dynamics, allowing for a more effective conceptualization of complex market relationships. This approach underscores the systemic, interconnected, and interdependent nature inherent in these relationships. This study contributes significantly to the comprehension of a Circular Economy (CE) within the context of a service ecosystem. Through this exploration, it advances the broader understanding of markets for sustainable solutions, offering insights into how such markets can be methodically scrutinized within the realm of academic studies.

The second major contribution of this research is to the idea of a CE and its relevance in RI practice by discovering that CE is a hybrid logic (Pache and Santos, 2013). The study closes a gap (Korhonen et al., 2018a) between studies of directly observable units of analysis such as resource consumption, fuel usage, wastes and emissions generation which are conducted in engineering and natural science, and studies in strategic, management and organisational studies or studies typical for social sciences (Korhonen et al., 2018b). This unique finding is important to reinforce the establishment of CE as an academic field.

CE originates from different schools of thought (e.g. industrial ecology, cradle to cradle, and natural capital) with the aim to combine otherwise unrelated findings and create a platform on which different strategies for the extension of resource-life can be discussed (Blomsma and Brennan, 2017). CE currently is in the “validity challenge period”, in which the vast scattered knowledge in theory and practice about different life-extending strategies such as reuse, recycling, remanufacturing, servitization, repair, waste-to-energy, product longevity approaches, and the cascading of resources is consolidated. The concept initially has predominantly been developed outside academia which led to the

problem that discussions around CE are not scientifically critical enough and focus too much on the business opportunity (Korhonen et al., 2018a).

Uncovering that CE is a hybrid logic confirms that CE as an academic field has not yet fully formed. Extant literature and academic discourse are missing an explicit theoretical or paradigmatic clarity regarding the CE concept (Korhonen et al., 2018a, 2018b). The study found that the idea of a CE is still challenged in its validity and inconsistencies and variations of definitions exist (Kirchherr et al., 2017). For a societal paradigm change toward a sustainable CE, both social and natural sciences need to be integrated in a more balanced manner which this study pushes forward. With the investigation of the phenomenon and the support of Institutional Theory, the study increased the coherence and understanding of the topic from a management perspective and emancipate the topic from its origin in engineering and design.

The third theoretical contribution is towards the understanding of the value creation mechanism in solution businesses. Value in research is in many cases ill-understood (Grönroos and Voima, 2013), and extant research has so far given little empirically founded explanation of how RI leads to value creation. This research provides a much-needed, empirically grounded, explanation of value creation by revealing the interconnectedness between the micro-activities of actors, the meso-configuration of a service ecosystem, and the macro-changes in the company's environment (Storbacka et al., 2016). It describes how the integration of different resources leads to different components of the value proposition and value creation for the achievement of economic, environmental, and social goals.

By doing so, it contributes to ontological, epistemological, and methodological considerations of the theory of the markets and value co-creation (Brodie et al., 2019), and reaching an agreement on how socially constructed value can be identified and described, how actors describe the process of value creation, and through which interactions actors co-create value in an institutional environment (Edvardsson et al., 2011). The study contributes to the understanding of value creation in service ecosystems by presenting a means-end chain approach (Gutman, 1982). This analysis exemplary

depicts how the mix of operant and operand resources leads to the achievement of sustainable value, by enabling the customers to achieve economic, environmental, and social goals and was found to be most useful when regarded as a dynamic and iterative cycle, rather than a linear process (Payne et al., 2020). This constitutes a methodological contribution to management research ready to be used and replicated by academics and professionals alike.

Further, extant research often lacks definitions and blurs the lines between resources, value propositions, ViU, value creation etc. The presented research method manifests a clear hierarchy of value based on established marketing literature (Mentzer et al., 1997). When moving up the hierarchy of value, customers think about products as bundles of attributes and attribute performances and form preferences for certain attributes based on their ability to facilitate desired consequences, reflected in ViU (Sánchez-Fernández and Iniesta-Bonillo, 2007; Woodruff, 1997). The findings suggest that the ViU constructs for similar companies and customers are likely to be the same, whereas the value propositions and the resources are idiosyncratic to the solution.

7.3 Managerial Implications

The findings of the study result in four main managerial implications. By focusing on these aspects, managers can drive resource integration practices that prioritize sustainability, address customer needs through value propositions, tackle challenges proactively, and leverage key drivers to foster successful and environmentally responsible business practices.

First, managers must change their resource integration practices to include environmental sustainability objectives while servitizing. Servitization is recommended as a business strategy to increase stewardship practice because firms can prolong the lifetime of products by designing them for upgradability, repairability, and potentially reduce resource consumption throughout the product's life cycle (Bocken et al., 2014; Evans et al., 2017; Lüdeke-Freund et al., 2018). Emphasizing circularity, resource efficiency, and product life cycle considerations will be essential in this process. The study revealed that

shifting from a product to a service market logic can be compatible with a sustainable production logic. Instances of sustainable production logic in this study include added service contracts, with components that allow circularity as the company buys back used equipment, remanufactures them, and resells them into other markets in second life. However, it can be conflicting and competing as well. Manufacturers need to consider practising stewardship in RI proactively to ensure that their solutions are sustainable and are not a mere spillover from economically driven servitization efforts. This means that they must consider the entire life cycles of products and services rigorously and not only cherry-pick and highlight the obvious environmental benefits some servitization efforts have, due to resource efficiency. The study suggests that companies must start somewhere small and continuously learn and improve, however as previously stated by Kirchherr et al. (2017), companies should withhold putting a CE label on small incremental changes.

Second, managers must develop customer-centric value propositions and continuously adapt their resource integration to the changing customer demands. Creating value propositions that cater to customer needs while highlighting the environmental benefits of sustainable solutions is crucial. Managers should tailor their offerings to address diverse customer requirements and interests in sustainability. The companies described in this study are all manufacturers of specialised components and equipment that started as sales businesses and continuously added services to their products. Of those companies, the solutions provided are available as sold products and the stewardship practice is an add-on to the product, suggesting that the idea of pure outcome-based solutions is more of a myth, rather than a practice. The recommendation for managers is to start somewhere and continue improving, or as de Jesus Pacheco et al. (2019, p. 916) called it “the transition process towards sustainable product-service systems must be performed incrementally instead than radically”. The collected data suggests no evidence that more sophisticated service agreements, such as outcome-based contracting, would lead to an increase in sustainability. Nevertheless, exploring the possibility of solution business should be on the strategic agenda of all manufacturers, and as Reim et al. (2015) suggest solution providers can be inclined to emphasise sustainability because it promotes exploring novel technologies, developing solutions, and implementing business models

that meet both economic and environmental goals”. Developing novel solution businesses that include stewardship practice not only helps the environment, but as one of the CE experts in the interviews responded “reducing the environmental footprint is the best indicator for innovation” – and being an innovative company is beneficial to the customers, convinces investors, and increases the reputation of the company within the society at large.

Managers should continuously assess and adapt resource integration practices to meet evolving customer demands and expectations regarding sustainability. Staying responsive to customer interests will enhance the value of sustainable offerings. While environmental sustainability is concerned with physical resources, the circularity of a solution can be assessed on a resource level. Value is idiosyncratic to each customer. This makes it difficult for manufacturers to understand which resources are required to facilitate value creation. The study confirmed what recent research suggests (Frow et al., 2014; Payne et al., 2020), that when considering a temporal dimension, value proposition development in solution business is not a linear process, but instead becomes an evolving circle. This study identifies that when companies use the implementation of CE principles in the RI with a means-end chain approach it helps to increase the legitimacy of the actions of how management strives for set goals. Some of the companies portrayed in this study have customers who show no interest in becoming more sustainable within the market. However, the manufacturers anyways increase stewardship, for example, to comply with regulations or internal stakeholder demands. When promoting solution business, providers should use the means-end chain approach to clearly explain to customers how they can achieve their goals through the integrated resources. Elements such as technical and customer integration are important, regardless of customisation, whether the solution is unique or based predominantly on standardised modules. As stated by Nordin and Kowalkowski (2010, p. 454) “it is not the bundling of offerings per se that characterises solutions; integration needs to deliver better customer outcomes than the sum of the individual components”. This study uses and suggests a means-end chain approach which can help companies to understand their own value proposition better and communicate the superiority of value packages more transparently. With the proposed means-end

methodology, managers can explore which resources contribute to achieving profitability, sustainability, and social goals, and thus understand how customer outcomes are delivered.

For larger companies, scalability and replicability of sustainable resource integration practices are critical considerations. Managers need to identify approaches that can be expanded across markets while maintaining their environmental benefits. The interest in sustainability aspects varies considerably among different customers and if customers do not care, then the benefits of advanced service provision for the safety and the environment will not attract them (Reim et al., 2019). For sustainability to be a selling point, it needs to be connected with a key customer requirement, to make a business case (Hallstedt et al., 2020). Managers must consider that even when a customer has initially no interest in sustainability aspects, the benefits from the solution must change, in particular when additional stakeholders with additional demands are involved at a later stage of the solution's lifetime. The relevance of addressing multiple stakeholders is particularly important, as companies are continuously both seeking legitimacy and proving that their activities lead to realising their organisational purpose and achieving strategic goals.

Third, managers must carefully assess the internal and external factors that complicate servitization for circularity in their company's service ecosystems. Understanding the challenges that may arise during the development and implementation phases of solutions is essential. To promote sustainable resource integration, managers need to proactively tackle obstacles such as high upfront costs, limited financial investments, and uncertain market demand. By identifying and finding innovative solutions for these barriers, managers can pave the way for successful and environmentally responsible servitization practices.

Many challenges in servitization and CE are fundamentally different. In servitization, the challenge is to get away from products and materiality, whereas CE is mostly challenged with technological features. The study confirmed what the literature suggests that challenges to circularity are because of technical aspects, but the data suggest that

managerial and psychological/sociological issues are at least as important, if not more important. Companies trying to increase their stewardship practice must, therefore, at all times consider the internal culture and the customer acceptance of new, more sustainable solutions, and not solely focus on the technical aspects of the challenge.

Academic (Bocken et al., 2016; Kirchherr et al., 2017) and practitioner (BSI, 2017; Ellen MacArthur Foundation, 2015a) literature suggest a variety of principles to increase stewardship practice in RI. The companies in this study successfully reused and remanufactured products and parts in their solution business and have those processes supported by digital platform services, which are the first steps towards sustainable solutions. They were, however, in particular struggling with the materials for their products as they are in all cases not renewable or only to a limited amount recycled, which suggests that new materials need to be continuously developed.

The companies in this study are specialised manufacturers, and in a global comparison relatively small. The findings of this study suggest that the complexity of global supply chains and their dependency on material producers and disposal companies makes it particularly difficult for smaller companies to become more sustainable. This is because they have no leverage over their suppliers. Therefore, the findings suggest that for the entire economy to become more sustainable, larger groups such as industry associations play a vital role and give weight and pressure upward in the supply chains.

Creating a company culture that embraces sustainability and stewardship is essential. Managers should promote an internal environment that encourages sustainable behaviours and aligns with the organization's sustainability goals. The most sustainable case of the three presented is an owner-led SME in which the owner CEO has the full decision power on how investments are made and what sustainability criteria must be met. Although research has found a significant positive correlation between environmental proactivity and financial performance (de Burgos-Jiménez et al., 2013), high upfront investment costs, unclear market demand, and lack of financial and time investments have been identified as obstacles in multiple studies (Guldmann and Huulgaard, 2020; Masi et al., 2018; Tura et al., 2019a; Yadav et al., 2020). Particularly

in larger companies, convincing decision-makers of a sustainable solution will be difficult as a major challenge is the scalability and replicability of sustainable business models. Several good practices in the CE remain mainly confined to a small scale and a (single) local context (Zucchella and Previtali, 2019). This can raise risk and uncertainty, due to the inadequate scale of the operations, and limits the (especially private), funding opportunities. Thus, scalability and replicability issues can represent a barrier to the adoption of circular practices and help to explain why sustainable business model innovation is not yet more widespread (Paletta et al., 2019).

Fourth, managers can rely on drivers to increase the success of their sustainable solution business. Emphasizing innovation as a driver for resource integration can motivate managers and employees to explore sustainable practices. Highlighting the positive impact on the company's environmental footprint and reputation will further drive adoption. The results from the single-case study identified internal and external drivers towards sustainability which were not previously identified in the literature. The findings suggest that if there is an alignment between the company's culture that embraces sustainability and practices stewardship and the employees' values and interest in sustainability, they are intrinsically driven to work for the company and need less supervision. Therefore, reducing costs and overheads. The study further found that physical proximity is a crucial factor in improving stewardship practice. This is particularly the case if the aim is to improve remanufacturability, where the engineering department must be close to the workshops. The study suggests that there is a particular potential for solution businesses to increase sustainability because the flat-rate contracts allow to reuse parts. Further, they allow to predict the return of vehicles from customers, which reduces the operational complexity for the manufacturer.

Inter-organisational collaboration for value co-creation in solutions may blur organisational boundaries, the key considerations pertaining to competitive strategy become gradually more ecosystem-level issues, ceasing to be organisation-level concerns. Managers should adopt an ecosystem-level approach when considering resource integration practices. Seeking long-term partnerships and collaborations that facilitate circular solutions will enhance value co-creation and foster sustainability. To

increase the quality of an ecosystem, the creation of sustainable value and therefore the achievement of economic, environmental, and social goals, are required. In addition to shifting the focus of strategic management from organisation to business ecosystems, the conception of business models becomes ever more an ecosystem-level subject, binding organisational value-creation strategies together. (Kohtamäki and Rajala, 2016).

7.4 Policy Recommendations

The study on several accounts identified policy-related issues which are important to decision-makers regarding both policies and norms. Extant research has discussed these issues in a number of studies from an institutional perspective, concerning the regulative drivers and barriers to CE implementation (Caldera et al., 2019; Do et al., 2022; Ranta et al., 2018b). Regulative drivers were identified in this study, and considering developments in policymaking, companies in future will increasingly be held accountable for their activities. While non-financial reporting for some organisations was already mandatory in the European Union, the requirements will be expanded in the new Corporate Sustainability Reporting Directive (CSRD) and from 2024 will require around five times more companies to report on their environmental and social sustainability.

The Greenhouse Gas Protocol has become a quasi-standard for many companies and industries to measure and account for their emissions. While a workable agreement to compare companies and their emissions, the shadow side has, in most recent reports, shown that major global companies claim to be carbon neutral by offsetting their emissions through low-quality compensation certificates. Environmental requirements are increasingly expanded into rules and legislation at an international level. Governments must create conditions where more sustainable practices are rewarded, and misbehaviour is penalized. Smaller companies, such as the ones portrayed in this study, in some cases, do require not more, but less regulation, to be innovative and able to bring their CS quickly to the market. With such measures, policymakers play a role through laws and regulations, fiscal incentives, public funding, and a flexible legislative regime supporting the launch of end of life products which are crucial to lowering uncertainty for companies to get invested in CE (Do et al., 2022).

First, the study found that regulations restrict and hinder reusing equipment in contexts other than the initial market. Obstructing laws and regulations are identified as a pressing barrier by businesses and policymakers (Kirchherr et al., 2018). Evidence from this research and the literature (Kirchherr et al., 2018) shows that companies want to cascade materials and products but are not allowed to which discourages them. Policy should encourage the reuse of equipment and be flexible when it comes to reintroducing assets into secondary markets. This could be done through establishing requirements for the reuse of products and incentivizing emerging reuse efforts and make it easier to cascade materials, including waste, across borders (Linder et al., 2017). As Hopkinson et al. (2018, p. 90) point out: “On top of a number of technical and structural barriers, there are a number of regulatory frameworks and directives that focus too strongly on classifying products as waste when they have reached their end-of-first-life stage.”

To better this situation, standards and nomenclature for remanufacturing need to be urgently established to address customers' concerns regarding quality and performance, as well as to overcome consumer uncertainty about the term remanufactured versus other terms such as refurbished, repaired, reconditioned, or as new (Hopkinson et al., 2018). Developing global trade and sales in remanufacturing requires cooperation between key players to actively exchange policies, technologies, and experiences with partners. International remanufacturing standards are required to increase the quality and reliability of remanufactured products. This is important to build awareness and confidence among policymakers and nations directly involved with the remanufacturing trade, as approaches to defining and providing quality assurance for remanufacturing currently vary by country. Due to the lack of standardisation and harmonisation, companies must navigate the regulation in each country, resulting in a hindering additional work.

Secondly, to promote repairing and remanufacturing practices, tax incentives should be implemented, particularly in high-income countries where product replacement is often preferred over repair. This has been prominently billed as an important stimulus for the transition to a circular economy by Stahel (2008), particularly regarding reduced labour taxes and higher taxation for the use of virgin materials. Sweden, for example, reduced the value-added tax for repair services (Kirchherr et al., 2018). Such policy interventions

and fiscal reforms create incentives for remanufacturing (Linder et al., 2017) and serve as a model for wider implementation, enhancing the competitiveness of repaired and remanufactured equipment.

Stricter laws should regulate the use of non-renewable raw materials, with lower taxes encouraging the use of recycled and reused materials while imposing higher taxes on non-renewable virgin materials to discourage their consumption. Non-renewable resources (e.g., carbon, oil, etc.) often have taxation levels comparable to or lower than renewable ones. Aggravating the problem is that virgin materials are considered easier to manage in the manufacturing system because they have a more consistent quality and a reliable supply (Guldmann and Huulgaard, 2020). In addition, existing national and international regulations mainly focus on recycling, rather than on other CE renovation activities such as reuse (Bressanelli et al., 2019). This is particularly important, as many virgin material prices in the EU are artificially low, since energy for producing these is frequently provided at subsidised rates. Such subsidies undermine the diffusion of more circular materials.

Third, the single-case study identified public procurement and tendering processes as being particularly helpful in giving smaller manufacturers a chance to grow and foster innovation. The reason for this is that the governments can and must set the requirements for sustainability in their tenders, whereas in a traditional business-to-business market, the price is the determining factor to win a tender, whether the solution is sustainable or not. While circular economy-oriented public procurement policies could potentially alleviate this issue for companies with business-to-government sales, Guldmann and Huulgaard (2020) in their review found that tendering requirements were more oriented towards cost than sustainability.

The high upfront investment costs for circular business models could be lowered by government intervention, e.g., through the provision of financial support. Seed-funds or low-interest loans can be provided to SMEs for capacity building in lean and green practices (Caldera et al., 2019; Kirchherr et al., 2018). Regulators already commonly

employ financial support as a policy instrument in the EU (Kirchherr et al., 2018). This would negate the commonly used excuse that CE is too expensive.

Fourth and finally, it is the companies' and associations' turn to increase stewardship practices in their respective industries. More than the regional law, companies are driven by international industry standards, which are developed and decided upon by their members. For example, industry-wide metrics such as allowing remanufactured products to contribute to firms' overall market share figures can hinder the perception and recognition of remanufacturing (Hopkinson et al., 2018). This highlights how industry bodies and wider system conditions can inadvertently hold back potential growth in CE activities yet can be relatively easily adapted with industry-policy agreements. These strong members, consisting of both customers and suppliers, must define minimum stewardship practice requirements and best practices for their members. Governments and authorities must work more closely with those industry associations to accelerate the transition towards a circular economy. For smaller companies, an industry support network can be created to connect SME industrial practitioners with technical experts to support lean and green implementation (Caldera et al., 2019).

These combined efforts can foster a more sustainable and circular economy that considers the stipulation of environmentally negative externalities. It is important for policy recommendations to remember that while environmental regulations often aim at influencing individual suppliers – for the collective good – they may have negative effects for societal and economic wellbeing, for example in the form of decreased competitiveness, lower employment or carbon leakage due to the relocation of companies (Tura et al., 2019b). It is therefore vital to have a better understanding of the collectively experienced tensions. This understanding would provide a basis for regulations and policies that could lead to less friction and support the optimization of well-being for a broader set of stakeholders, including societies and economies as a whole.

7.5 Limitations and Future Research

The presented study has limitations, which at the same time offer the potential for future research. This study was set out to get an in-depth understanding of cases in manufacturing in particular industries. Future research should reproduce the study in other industrial ecosystems as well as in the consumer goods markets. The study further used a qualitative inquiry for this research and the author encourages identifying and using other methods to explore the micro/meso/macro link in service ecosystems. The study focused on institutional complexity as a main theoretical construct. Future studies should explore the phenomena further by building on other constructs from Institutional Theory.

Vargo and Lusch (2016) and Kohtamäki and Rajala (2016) began an important stream of research concerning institutional approaches and value creation. Further research is needed to bridge the gap between the neo-institutional approach and S-D logic. Research in service-dominant logic proposes that the integration of both customer and supplier leads to value creation. However, this study focused on the manufacturer's resources. Future research could identify and describe the means-end chains for resources contributed by the customer. Further, the analysis of the single-case study used a simplified version of the means-end chain analysis. Means-end chain research suggests conducting tailor-made interviews and laddering, combining quantitative and qualitative research, which would increase the reliability of the findings. Previous research used micro, meso, and macro levels to describe service ecosystems (Frow et al., 2019, 2014), whereas the presented research was restricted to a micro and macro level of analysis. Future research would benefit from considering a meso level to better understand how practices and institutions interact.

Future research should further investigate organisational culture and strategic examples of organisations servitizing for stewardship such as organisational culture, strategic thinking and strategy formulation in an organisation, corporate or organisational social responsibility, collaboration culture in a network of processes, companies and sectors, intra-organisational vs. inter-organisational learning, capabilities for radical innovations,

organisational inertia or path dependency, organisational transitions, the resilience of different organisational types, sense of community in a network of organisations etc.

Further research should continue considering the application of the new Institutional Theory and analyse how institutional structures affect the participating organisations. For example, the institutional perspective may enrich the understanding of how digitalisation is transforming the prevailing logics and practices of co-production and co-creation. It can also lead to a more comprehensive view of how new practices become “habitualised” and objectified. The research has identified the logics present in sustainable solutions. Further research would benefit from a more systematic understanding of the processes through which these different logics are strategically combined by solution providers.

This study focused on relatively small companies with limited leverage in global supply chains, aiming to understand their sustainability efforts through an examination of institutional logics within the field. However, it is important to acknowledge the limitation of not investigating how institutional arrangements change, specifically through institutional entrepreneurship or institutional work. Nonetheless, the challenges and drivers identified in this research provide a valuable starting point for future investigations. Further research can explore methods to enhance internal mechanisms and capabilities, such as dynamic capabilities or resource-based view, to foster the development of sustainable customer solutions. The proactive and innovation-focused strategies adopted by the companies underscore the importance of innovation over mere compliance. Remarkably, legal compliance was not a major concern for the companies as they all exceeded minimum requirements, opening up the question if these requirements are rigorous enough.

The case selection suggests that these companies must rely on innovative solutions, combining stewardship practices with economic value creation, as they lack the leverage for forceful demands in their supply chains. In this regard, future research can explore the application of Transaction Cost Theory and the Resource-Based view to understand how manufacturers can leverage their power upstream in the supply chains, increase vertical integration, and foster collaborative eco-systems for sustainability. Moreover,

investigating how larger multinationals develop sustainable customer solutions and exploring potential shared barriers and drivers would contribute to a more comprehensive understanding of sustainable practices across different organizational contexts. This study and the proposed avenues for future research collectively contribute to advancing sustainable management practices, offering valuable insights for both smaller companies and larger multinational corporations in their pursuit of sustainability within global supply chains.

At last, the study presented used the ideas of trade-offs which represent specific situations in which organisations have to choose one pathway and ignore another one. Understanding the mechanisms of barriers and the causal relationship of barriers and goal achievement is important to better understand how to overcome them. Future important research should be conducted using Paradox Theory (Smith and Tracey, 2016) to explore how tensions can be resolved and ultimately allow reconciling the achievement of economic, environmental, and social goals and develop service ecosystems that create sustainable value.

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Appendix A Data Collection Protocol

The data collection protocol was adjusted for each of the 43 semi-structured interviews to suit the company, role, and seniority of the interviewee in order to extract the most information from each of the interviews. An example of each of the interviewee categories is subsequently attached.

A.1 Interviewee CA2: Head of Global Sourcing CableCo

1. What is your role at CableCo?
2. How are you involved in the value proposition development?
3. How is the value proposition influenced by circular economy?
4. On what parameters do you measure success?
5. How is reducing negative environmental impact linked to measuring the company's performance?
6. Could you please explain how you collaborate with your customers when developing solutions?
 - 6.1. How do you integrate the suppliers' resources in the development process?
 - 6.2. What do you learn from your customers and vice versa?
 - 6.3. How do you facilitate the resource integration between the customer and other stakeholders?
 - 6.4. What do you get more out of: collaborating in solutions, compared to sales business?
7. How do you communicate your value propositions to your customers?
8. How does business development align and integrate product development, technology development, service development? Is it an integrated process?
9. Are there any links or ambitions between increased services reducing resources?
10. What are the possibilities when having provable sustainability in your operations and market offerings?
11. Do you engage with partners outside the organisation to take on stewardship roles?
12. What are the procurement criteria to become a supplier?
13. Where are interventions towards reducing resources located within CableCo?
14. CE is more about the design and lifecycles of the products, as compared to sustainability, which had a focus on the processes. Do you have any processes in place that help saving resources through, for example, design or end of life considerations?
15. I heard from an example where colleagues wanted to change packaging to reduce waste. That would have led to additional articles and a reduction of volume and discounts for the existing packaging. Apparently, it was killed in procurement. What

- could you do to prevent such situations and encourage sustainability related issues, even though they don't have an immediate cost reduction?
16. Is there an increase in legislation and regulation towards more resource efficient products?
 17. How is sustainability in procurement practice?
 18. What was your experience being engaged with the project?
 19. How are the suppliers integrated in the operations, for example in packaging?
 20. Do you push responsibility upstream the supply chain? Can you even do so on a product level?
 21. Is it, or becoming, an order qualifier to be for example ISO or ECOVADIS certified?
 22. What does sustainability mean in CableCo?
 - 22.1. Why is sustainability important?
 23. How important is the ownership structure of CableCo when it comes to bringing sustainability onto the agenda?
 24. Is sustainability, CE, or resource efficiency officially on the strategy agenda? How is the senior management level acceptance and climate? What are the challenges to bring sustainability onto the strategy agenda?
 25. Is sustainability becoming an order qualifier?
 26. An increasing trend in major industries and a principle of circular economy is that companies should take on stewardship over products and services and manage the direct and indirect impacts of their decisions and activities within the wider systems they are part of.
 - 26.1. How has sustainability and taking on stewardship become part of the way you do business?
 - 26.2. From where do you experience pressures towards taking on stewardship?
 - 26.3. Do you feel increased pressure in the market to take on a stewardship role?
 - 26.4. Who accepts taking on stewardship in solutions?
 - 26.5. Do you see changes in the competition's behaviour?
 27. From where do you experience pressure towards taking on stewardship?
 - 27.1. What motivates the post to take on a stewardship role?
 - 27.2. Is being a steward voluntarily and proactive or a result of external pressures?
 28. How do you practice this stewardship role in your organisation?
 - 28.1. Could you name examples of where it is actively promoted?
 - 28.2. How do you actively practice this stewardship in the business development process?
 - 28.3. Could you explain to me how this is measured?
 - 28.4. How has this changed over the time? Do you remember a particular event that stood out?
 - 28.5. Does stewardship thinking get rewarded?
 29. How do you engage with the customer to co-develop strategies for resource stewardship?

- 29.1.How do the customers react to your sustainability efforts?
- 30. Do you work together with suppliers to develop stewardship upstream on the supply chain?
- 31. How important is the sustainable reputation to CableCo?
 - 31.1.How does that show/manifest, or what are tangible examples?
 - 31.2.Are there examples where the image is better than the actual operations?
 - 31.3.What do you get out of having a sustainability component in your value proposition?

A.2 Interviewee PU9: Purchasing Manager PumpCo

1. What is your role at PumpCo? Where do you report to?
2. How are you involved in the value proposition development?
 - 2.1. How is the value proposition influenced by the circular economy?
3. On what parameters do you measure success?
 - 3.1. How is reducing negative environmental impact linked to measuring the company's performance?
4. Could you please explain how you collaborate with your customers when developing solutions?
 - 4.1. How do you integrate the suppliers' resources in the development process?
 - 4.2. What do you learn from your customers and vice versa?
 - 4.3. How do you facilitate the resource integration between the customer and other internal stakeholders?
 - 4.4. What do you get more out of: collaborating in solutions, compared to sales business?
5. How do you communicate your value propositions to your customers?
6. How do you inform your value propositions with sustainability?
7. How does business development align and integrate product development, technology development, service development? Is it an integrated process?
8. Are there any links or ambitions between increased services reducing resources?
9. What are the possibilities when having provable sustainability in your operations and market offerings?
10. Do you engage with partners outside the organisation to take on stewardship roles?
11. Where are interventions towards reducing resources located within PumpCo?
12. Value engineering
 - 12.1. What has been learned?
 - 12.2. How did it change the way you look at the suppliers and supply chain?
13. What's the CAPEX/OPEX/TCO structure of products, for example who owns the castings?
14. Do you know of any sustainable procurement ranking such as Ecovadis?
15. How does working with EPC contractors effect the procurement and how you work with suppliers?
16. How much material do you use from recycled resources and how much from virgin resources?
17. What are the procurement criteria to become a supplier?
18. What does sustainability mean PumpCo?
 - 18.1. Why is sustainability important?
19. How important is the ownership structure of PumpCo when it comes to bringing sustainability onto the agenda?

20. Is sustainability, CE, or resource efficiency officially on the strategy agenda? How is the senior management level acceptance and climate? What are the challenges to bring sustainability onto the strategy agenda?
21. Is sustainability becoming an order qualifier?
22. An increasing trend in major industries and a principle of circular economy is that companies should take on stewardship over products and services and manage the direct and indirect impacts of their decisions and activities within the wider systems they are part of.
 - 22.1. How has sustainability and taking on stewardship become part of the way you do business?
 - 22.2. From where do you experience pressures towards taking on stewardship?
 - 22.3. Do you feel increased pressure in the market to take on a stewardship role?
 - 22.4. Who accepts taking on stewardship in solutions?
 - 22.5. Do you see changes in the competition's behaviour?
23. From where do you experience pressure towards taking on stewardship?
 - 23.1. What motivates the post to take on a stewardship role?
 - 23.2. Is being a steward voluntarily and proactive or a result of external pressures?
24. How do you practice this stewardship role in your organisation?
 - 24.1. Could you name examples of where it is actively promoted?
 - 24.2. How do you actively practice this stewardship in the business development process?
 - 24.3. Could you explain to me how this is measured?
 - 24.4. How has this changed over the time? Do you remember a particular event that stood out?
 - 24.5. Does stewardship thinking get rewarded?
25. How do you engage with the customer to co-develop strategies for resource stewardship?
 - 25.1. How do the customers react to your sustainability efforts?
26. Do you work together with suppliers to develop stewardship upstream on the supply chain?
27. How important is the sustainable reputation to PumpCo?
 - 27.1. How does that show/manifest or what are tangible examples?
 - 27.2. Are there examples where the image is better than the actual operations?
 - 27.3. What do you get out of having a sustainability component in your value proposition?

A.3 Interviewee EV9: Head Fleet Management EVCo

1. In many of your customer and product segments you refer to solutions.
 - 1.1. Could you explain what customer solutions mean to EVCo and how you define them?
 - 1.2. What is your role in the development process of these solutions?
 - 1.3. For how many years have you been involved in value proposition development?
 - 1.4. If at all, for how many years have you been involved in sustainability related or circular economy topics?
2. What is it that customers value in the EVCo solutions?
 - 2.1. On what parameter is that measured?
3. How do you communicate the value proposition to your customers?
 - 3.1. Is there anything that stands out compared to competition?
 - 3.2. How do you align your goals?
4. Could you please explain how you collaborate with your customers when developing solutions?
 - 4.1. How do you integrate the customers resources in the development process?
 - 4.2. What do you learn from your customers and vice versa?
 - 4.3. How do you facilitate the resource integration between the customer and other internal stakeholders?
 - 4.4. What do you get more out of: collaborating in solutions, compared to sales business?
5. From where do you experience pressure towards taking on stewardship?
 - 5.1. What motivates EVCo to take on a stewardship role?
 - 5.2. Is being a steward voluntarily and proactive or a result of external pressures?
6. An increasing trend in major industries and a principle of circular economy is that companies should take on stewardship over products and services and manage the direct and indirect impacts of their decisions and activities within the wider systems they are part of.
 - 6.1. How has sustainability and taking on stewardship become part of the way you do business?
 - 6.2. From where do you experience pressures towards taking on stewardship?
 - 6.3. Do you feel increased pressure in the market to take on a stewardship role?
 - 6.4. Who accepts taking on stewardship in solutions?
 - 6.5. Do you see changes in the competition's behaviour?
7. How do you practice this stewardship role in your organisation?
 - 7.1. Could you name examples of where it is actively promoted?
 - 7.2. How do you actively practice this stewardship in the business development process?
 - 7.3. Could you explain to me how this is measured?

- 7.4. How has this changed over the time? Do you remember a particular event that stood out?
- 7.5. Does stewardship thinking get rewarded?
- 8. How do you engage with the customer to co-develop strategies for resource stewardship?
- 8.1. How do the customers react to your sustainability efforts?
- 9. Do you engage with partners outside the organisation to take on stewardship roles?
- 10. Do you work together with suppliers to develop stewardship upstream on the supply chain?
- 11. How important is the sustainable reputation to EVCo?
 - 11.1. How does that show/manifest, or what are tangible examples?
 - 11.2. Are there examples where the image is better than the actual operations?
 - 11.3. What do you get out of having a sustainability component in your value proposition?
 - 11.4. How has that changed over the years?

A.4 Interviewee C8: VP Strategy and Business Development

2ndMail

1. Could you please explain to me what your role is? Who do you report to?
2. From what I understand from your communication is that you have a three-year strategy cycle ending this year? Could you explain to me how that is developed? In a bottom/up or top/down approach?
3. Will the circular economy be part of the new strategy? How do you prioritise?
4. Could you give me an outline of the 2ndMail's sustainability strategy? Is it an integrated part of the company's strategy or does it stand separate?
5. The idea of circular economy is to design out waste and decouple economic growth from resource consumption. How do you balance these goals? Growing your business while reducing resources?
6. How is strategy in a government owned company different than in the private sector?
7. Is the local competition a threat?
8. How important are strategic partnerships such as with EVCo? Is this kind of more integrated supplier relationship becoming more important?
9. How important was it that the scooters EVCo supplies are 'sustainable'? Was it a main criterion?
10. I read in one of your reports that you want to achieve a 2hours turnaround time from purchase to delivery. How do you manage the balance between sustainability and changes in consumer behaviour?
11. What are your biggest business risks that you are facing?
12. 2ndMail has some 18500 employees. How do you break down your strategy to all these employees? How do you make sure they know what circular economy and what it means for the individual?
13. Is acting and deciding sustainable actively rewarded? For example, are there targets in manager's performance reviews?
14. In the private sector it is profit first and the rest follows. How are your strategic goals weighted? I assume you have EBIT goals but as well carbon/CO2 goals?
15. Is there a strategy 2ndMail follows to develop, implement, and diffuse new ideas?
16. Is the sustainability agenda driven from CEO? Or from the CSR team?
17. What does the Post gain from being more sustainable?
18. Is it access to resources?
19. If we look outside the company, from where do you experience pressures to become more sustainable?
20. What is the risk or the sanctions if you are not behaving sustainably?
21. How important is it to your organisations that you have suppliers that are sustainable or circular? Is it an order qualifier?
22. Do you nudge your customers to adopt certain practices?

Appendix B Unified 2nd order Categories Multiple-Case Study

Appendix Table B-1: Coding for 3rd Order Dimension Product Market Logic

Case	1 st Order Codes Statements that mention....	2 nd Order Categories	Unified 2 nd Order Category
CableCo	Only downstream communication	No customer feedback	No customer feedback
PumpCo	Low value plastic pumps	No service because low value	Low value, passive components
CableCo	Producing passive components	Passive components	
EVCo	No added value through pay-per-use; Product sales with service add-on	Limited-service component	No interest for advanced service and supplier integration
PumpCo	Customers have no interest in service and repair; Oil and gas is mainly warranty period not uptime	No interest in service	
PumpCo	Customers don't want too much supplier integration; Customers don't want to share operation data; Mostly product selling as customers don't want to lose control	No wish for supplier integration	
PumpCo	Service is an add-on to the sold products; Service unit is separate business unit	Separate service	
EVCo	No special servicing because of takeback	No special servicing because of takeback	Internal product focus
PumpCo	Customers were not involved in value engineering; value engineering only involved production not TCO; Service division only limited involved in value engineering	Product focus in value engineering	
CableCo	Producing parts according to industry standards	Confining industry standards	Confining industry standards
PumpCo	High value pumps defined by standards; Norms must be considered in all engineering; Norms prescribe which metallurgies to take; Standards leave little room to design, Products in oil and gas are commoditised through standards, Difficult to change standards	Standards define products	
PumpCo	Pumps are sold to EPC; EPC have no interest in TCO; For EPC pumps only must last first 2 years; End customer does not tell EPC to use TCO	No interest in TCO by EPC	No interest in TCO
EVCo	Low acquisition cost over TCO	No consideration of TCO	

Appendix Table B-2: Coding for 3rd Order Dimension Service Market Logic

Case	1 st Order Codes Statements that mention...	2 nd Order Categories	Unified 2 nd Order Category
CableCo	Assemblies instead of parts; Design support for customers products; Monitor lifecycle; Outcome focus; Reuse packaging	Added service	Service in the use phase
PumpCo	Co-develop IOT solution; IOT to monitor pumps and pipes; Ownership of IOT data	Remote monitoring	
PumpCo	Repair on 3 rd -party equipment; Retrofit 3 rd -party equipment	3 rd -party equipment	
EVCo	Increasing service with older vehicles; Reusing harvested parts for repairs; Service operations in ERP; Service partner network; Service partners return parts for remanufacturing	Service operations	
CableCo	Challenge to be good engineering and mass production	Capabilities	Engineering and manufacturing capabilities
EVCo	Problems in remanufacturing; Remanufacturing process	Remanufacturing	
PumpCo	Different divisions; EATS (Engineering, assembly, testing, and shipping); Service division; Taking on jobs others can't; Technology development	Capabilities	
PumpCo	Challenge in additive; Develop additive manufacturing capability; Forerunner in additive manufacturing; Hybrid approach; Lack of protocols for additive manufacturing; Reduce number of spare parts; Short lead time	Spare parts	
PumpCo	Engineering strength; High price for high quality; Relationship throughout lifetime; Supporting customers	Reputation	
EVCo	2 nd life vehicle condition; 2 nd life vehicle price; 2 nd life vehicle warranty; 2 nd life vehicle sales channels	Sell 2nd life vehicles	EoL solution
PumpCo	Adapt existing equipment; Adjust to changing requirements; Cascading to new use; Not replacing all equipment; Replacing internals of pump	Retrofit	
EVCo	Take back condition; Take back from all customers	Take back vehicles	
EVCo	2 nd life batteries are not competitive; At some point battery needs recycling; Batteries for private customers after professional delivery; Location of most batteries is known due to contracts; Recycling instead of incinerating; Saturated battery market; Unknown condition of batteries	Battery lifecycle	
CableCo	Closeness to customer	Closeness to customer	Co-development with customers and suppliers
EVCo	Business intelligence through data; Efficient fleet management; Monitoring driver; Monitoring vehicles	Fleet management	

Appendix Table B-2: Coding for 3rd Order Dimension Service Market Logic

Case	1st Order Codes Statements that mention....	2nd Order Categories	Unified 2nd Order Category
PumpCo	Alliance agreements; Joint-industry-project; Long lasting relationships; Speciality development	Co-development	
CableCo	Co-develop solutions; Custom tailored solution; Customer driven development; Designed for purpose; Develop solution instead of part	Solution development	
EVCo	Co-development of solutions; Development process; Inform solution development; Initiating development	Solution development	
PumpCo	supplier collaboration; Value engineering	Solution development	
EVCo	Battery price; Customer preference; Customer segments; New business model for 2nd life vehicles; Offer solution to problem; Public tender	Customer solutions	
EVCo	Battery reuse can be communicated by customer; Ensure performance; No pay per use; Reason to by choose EVCo	Customer Value	Quantifiable KPI
PumpCo	Perceived value and KPI; Solution attributes	Customers value	
PumpCo	Energy consumption; Energy efficiency; Limits to efficiency	Efficiency	
CableCo	Change in customers business models	Change in customers business models	
EVCo	Customisation over standardisation; Tailored to customer requirement	Customisation	Customisation
PumpCo	Customised casts; Different product types; Environmental consciousness; EPC; Semi standard compliant	Customer segments	
EVCo	Uptime and penalties; Contracts with service partner and customer; Different service levels; Duration of contracts	Service contracts	Service contracts
PumpCo	Uptime	Uptime	

Appendix Table B-3: Coding for 3rd order Dimension Traditional Production Logic

Case	1 st Order Codes Statements that mention....	2 nd Order Categories	Unified 2 nd Order Category
CableCo	Customers and industry prescribe specification; functionality is always prime objective, not EoL; Only cost pressure, no sustainability pressure; Only RohS and REACH free, not disassemble, REACH, RoHS, Cost and technical functionality are what is asked by customers; Reel is part of price and part	Customer requirement	Driven by cost not sustainability
EVCo	No interest in TCO; No interest in sustainability in co-development; No sustainability requirement in tender; Only sustainable delivery of interest, not production; Resource efficiency is side effect	No interest in sustainability by customer	
PumpCo	As cheap as possible; EPC want low CAPEX; Technical feasibility and cost over sustainability	Cost is driver	
EVCo	Early replacement of vehicle	Early replacement of vehicle	
EVCo	Ensuring uptime; Regular maintenance	Maintenance	Too high internal cost
EVCo	Cost for battery recovery; Remanufacturing needs to be economically viable	Cost for remanufacturing	
CableCo	Efficient design works against economies of scale; Less cost is the only incentive to reduce material; Little internal culture for environmental design; No incentive for resource efficient design other than cost; no internal guidance on EoL, only technical and economically feasible; Reducing packaging because of cost, not environment; Sustainability requirements come from customer, not external; Sustainability KPI are missing	Internal culture	Internal culture
PumpCo	Reduced sustainability due to low economic performance; Sustainability not part of business strategy	Internal sustainability	
PumpCo	Customer request could incorporate environment in value engineering; Value engineering didn't consider environment	Value engineering	
CableCo	No interest or knowledge about EoL; EoL vehicles get shredded; No interest or knowledge about EoL; Not produced for easy EoL assembly; Not proceed with intended EoL; Not sure what happens at the customer EoL	EoL Strategy	
CableCo	Bioplastics lack technical properties, Complex integrated parts; Difficult to identify material at EoL; Difficult to recycle parts; Mix of plastic that cannot be recycled; More recycling material leads to less performance for not sufficient cost savings, Reusable cable reels; Technical limitation to lifetime; Technically not possible to produce sustainably	Technical	Technical limitations to sustainability

Appendix Table B-3: Coding for 3rd order Dimension Traditional Production Logic

Case	1st Order Codes Statements that mention....	2nd Order Categories	Unified 2nd Order Category
PumpCo	Additive manufacturing driven by lead time; Challenge to replicate additive manufacturing; No environmental benefit from additive manufacturing	Limits to additive manufacturing	
PumpCo	Additive manufacturing has different properties; Material required for vibration and abrasion; Safety factors	Properties	
EVCo	Sustainability traded off for safety	Safety requirements	
EVCo	Cladding can't be reused; No recycling of plastic; Not designed for remanufacturing; Rust	Recycling	Recycling
PumpCo	Recycling only for economic reason; Virgin materials required for special alloys	Recycle	
EVCo	Hindering regulation	Regulation	Regulation and standards
PumpCo	Industry standard; No regulatory requirement; Standards dictate	Regulation and standards	

Appendix Table B-4: Coding for 3rd Order Dimension Sustainable Production Logic

Case	1 st Order Codes Statements that mention....	2 nd Order Categories	Unified 2 nd Order Category
CableCo	Customers'' business models require longer lasting products; ISO 14001 is not required but expected; Open for sustainability at same price	Customer requirements	Customers requirement for sustainable practice
PumpCo	Geographic different interest in sustainability	Customer interest in sustainability	
CableCo	Financial institutions make pressure for carbon and climate considerations.	External pressure	External pressure to adapt sustainable practice
PumpCo	ISO certification; Legislation is biggest driver	Norms and regulation	
CableCo	Company is open to resource efficient ideas; Departments are measured against their energy saving; Internal guidance for environmentally friendly design; New CSR strategy; Small sustainability initiatives take place	Internal culture	Internal sustainable culture
EVCo	Cost for sustainability; Sustainable ideology; Working for sustainable company	Sustainable culture	
PumpCo	Development division; Rewarding sustainable innovation; Value engineering	Development	Sustainability informed development
EVCo	EoL thinking in development; Informing development; Model maintenance process	Development	
CableCo	Labour market wants to work in a sustainable company	Reputation	Sustainable image
EVCo	Showcase 2nd life; Sustainable delivery	Image	
PumpCo	Carbon capture; Cause of sustainability	Sustainable technology	Sustainable technology
CableCo	Supplies to green business	Market	
PumpCo	Audit; Good quality supplier; Supplier collaboration; Supplier requirements	Supplier	Supplier requirement
CableCo	Industry prohibits certain materials	Non-Toxic resources	Pure and nontoxic materials
CableCo	Design to cost increases resource efficient design; Recycling in production process takes place; reduce energy use in use phase; Reduce resources due to adding services; Reduce resources due to better quality; Reduce storage and transport cost through streamlined packing; Reduce transport volume for same amount of products; Reusable cable reels; Reusable packaging	Resource efficiency	Resource efficiency
EVCo	Cost saving; Procurement; Service partners; Sustainable practice; TCO	Sustainability	Additive manufacturing
PumpCo	Complex parts; Hybrid technology; Less spare parts; Licence files for spare parts; Short lead times over low cost	Additive manufacturing	
EVCo	Driver feedback; Durability; Performance	Use-phase	Efficiency in use phase

Appendix Table B-4: Coding for 3rd Order Dimension Sustainable Production Logic

Case	1st Order Codes Statements that mention....	2nd Order Categories	Unified 2nd Order Category
PumpCo	99% of energy used in use phase; Customised casings to increase efficiency; Energy efficiency is driver; Energy efficiency is selling argument	Efficiency	
PumpCo	Monitoring to increase efficiency in operation; Monitoring to indicate malfunction in system	Monitoring equipment	
PumpCo	Aftermarket division; Core value to save resource and energy; Determination to fix rather than replace; Different divisions for production and after market; External sustainability assessment; Saving energy in production	Sustainable operations	
CableCo	Financially viable to have longer lasting products; industry demands longevity and safety; long lasting products	Longevity	Keep value high for as long as possible
EVCo	Harvested parts; Parts from maintenance	Reuse parts	
EVCo	Take back channels; Take back conditions	Take back	
EVCo	Remanufacturing process	Remanufacturing	
EVCo	2 nd life condition; 2 nd life price	2 nd life	
PumpCo	Adjust to new requirements; Reuse pumps in different application	Retrofit	
PumpCo	Products can be recycled; Reclaiming sand in foundry; Recycling for financial reason; Using recycled materials	Recycling	Recycling
EVCo	Battery lifecycle; Battery recycling process; Condition of battery	Battery	
EVCo	No market for battery reuse and recycle; State of the art battery recycling	Battery after 1 st life	

Appendix C Detailed Description of Complexity in Plurality in Logics

Appendix Table C-1: Conflicting logics in CableCo

Instance of logics	Service logic	market	Traditional production logic	Source of complexity		Cause	
				Internal	External	Means	Goal
Cable reels, although reusable, are made from fossil-based polymer. [CA8, CA9]	Added service		Technical		The market has no alternative products	The company would use others if available	
The company engages much in developing components and parts together with the customer, such as antennas and sensors that are then built into the body. As there is no requirement for resource efficiency or EoL scenarios from the customer, these aspects are not taken into consideration in the design. [CA6]	Solution development		EoL Strategy		It is the customers that have no interest		The values of the customers don't require sustainable production
Although the design is made together with the customer, the EoL is not known as the customer doesn't care. [CA7]	Solution development		EoL Strategy		It is the customers that have no interest		The values of the customers don't require sustainable production

Appendix Table C-2: Competing logics in CableCo

Instance of logics	Service logic	market	Traditional production logic	Source of complexity		Cause	
				Internal	External	Means	Goal
Reusable packing needs to be shipped back, otherwise its environmental nonsense [CA2]	Added service		EoL Strategy	The company must make a choice and develop the network			It's a matter of the cost and margin
The solutions are designed to cost, that means that resources are reduced to a max but only from a financial viewpoint [CA7]	Solution development		Internal culture	The company designs within its limits	The customers are not willing to pay more		The motive to save resources is financial, not environmental

Appendix Table C-3: Compatible logics in CableCo

Instance of logics	Service market logic	Traditional production logic	Source of complexity		Cause	
			Internal	External	Means	Goal
Cable reels are optimised for transport and made from plastic so they can be reused [CA8, CA9]	Added service	Resource efficiency	The design lends to sustainability		The design of the reels suits sustainable production	
In some cases, the company supplies cables on machine coils that are then directly put into the customers production process. These coils are reusable and are a deeper integration into the customer's supply chain. [CA5]	Added service	Resource efficiency		Request comes from customers	Reusable machine coils reduce the resource use	
Reusable packing for lathed parts that get shipped back to CableCo. [CA2]	Added service	Resource efficiency	The company can save/reduce resources	The customer does not have dispose packing	Reusing the packaging leads to less virgin material use	
The development of an actively cooled EV charging cable allows to use less copper to compensate for the currency in the cable. The company has developed the entire unit; a pump, a cooling device, a cable that can transport fluid and the connector which takes them away from being a passive component manufacturer to a solution provider. [CA4, CA5]	Solution development	Resource efficiency		The customer wanted a complete unit	The technical solution led to less material	
The change towards a service logic in the automotive industry is beneficial for CableCo who are specialised on high quality cables. The cars in access-based mobility drive much more miles in a shorter time, which means that the components are stressed more. [CA5]	Change in customers business models	Customer requirements		The market changes		Coincides with the company's core competence

Appendix Table C-4: Conflicting logics in EVCo

Instance of logics	Service logic	market	Traditional production logic	Source of complexity		Cause	
				Internal	External	Means	Goal
Certain parts are not possible to remanufacture because of design or damage. [EV6]	Remanufacturing		Recycling	Design stem from within the company		Different design would allow for remanufactures	
EVCo has parts such as plastic, steel, and batteries which they must recycle or incinerate because there is no market for end of life materials and the virgin materials are too cheap on the market. [EV5, EV10]	Remanufacturing		Recycling		No market exists for EOL materials		The values of the resource markets rather use cheaper way of extracting virgin material
	Battery after 1 st life		Battery lifecycle				
Even though the vehicles are known to be taken back after the first life and remanufactured, they are not serviced any better in the 1 st life. [EV3, EV8]	Service operations		Maintenance	Service during 1 st life is by EVCo and could be done differently.			No interest in servicing better in the 1 st life
Sustainability is never the main driver for a decision to choose EVCo's vehicles, efficiency is driver – sustainability only a nice side effect. [EV3, EV7, EV9]	Customer Value		No interest in sustainability by customer		Customers are only interested in sustainability as a side effect		Customers value efficiency over sustainability
	Customer solution						
Regulation does not allow to change the initially declared maximum speed of 2 nd life vehicles which reduces the number of potential customers. [EV5]	Customer solutions		Regulation		EVCo must comply with external regulation.	The regulation could be changed, and exemptions made.	Requirement for sustainability in regulation not big enough

Appendix Table C-5: Competing logics in EVCo

Instance of logics	Service market logic	Traditional production logic	Source of complexity		Cause	
			Internal	External	Means	Goal
Remanufacturing needs to be economically viable and create no additional cost. [EV5]	Remanufacturing	Cost for remanufacturing	It's the company's decision if they want to remanufacture or not			Economic viability is valued higher than sustainability
A higher uptime requires more resources and could be traded off for sustainability. [EV3, EV8]	Service contracts	Maintenance	It's the company's decision on how they provide the uptime	It is the customers decision to what uptime they demand	Sustainable uptime could be achieved at EVCo's lower margin	The customer values uptime higher than sustainability
Even though the vehicles would last much longer, customers only use them for 5-7 years and replace them for newer ones. [EV3]	Customer solutions	Early replacement of vehicles		It is in the customers control to use the vehicles longer	'	The customers could use the vehicles longer but value comfort and new vehicles more

Appendix Table C-6: Compatible logics in EVCo

Instance of logics	Service market logic	Traditional production logic	Source of complexity		Cause	
			Internal	External	Means	Goal
The take back agreement that EVCo has with major customers has as part of their solution allows to plan and establish remanufacturing operations for the vehicle with respective sales channels and develop the recycling operations for the batteries. [EV2, EV3, EV4, EV5, EV6, EV7, EV8, EV10]	Sell 2 nd life Battery lifecycle Take back vehicles Service operations Remanufacturing	2 nd life Battery Remanufacturing Reuse parts Sustainability Take back Development	It is the company's decision what they do with the vehicles after take back		The remanufacturing is the sustainable answer to the customer request to take back	The company chooses to remanufacture the vehicles over recycling and disposing
The flat-fee service contracts that are part of the solution allows to reuse refurbished parts out of the part-harvesting and the service operations. [EV5, EV8]	Service operations	Reuse parts				
Through the fleet monitoring, EVCo's vehicles give feedback to the drivers and reduce energy and wear through efficient driving. [EV9]	Fleet management	Use-phase		The customer increases efficiency		Driving more efficiently reduces the cost and energy use
The engagement with the customer, the data from the fleet management and the reports from the service partners allows EVCo to understand their products and use thereof and customer better and based on that can improve them to last longer and be more efficient. [EV4]	Solution development	development	The improvement of the solutions is an internal process		The means that lead to increased longevity and efficiency are the result of the service logic	Increasing efficiency and longevity reduces cost and resources required
Most customers are state owned and fall under public procurement in which they must consider TCO and not the cheapest investment, which leads to less resource consumption due	Customer solution Customer value	Sustainability		Customer's procurement requires to consider TCO		The customers procurement requirement have

Appendix Table C-6: Compatible logics in EVCo

Instance of logics	Service market logic	Traditional production logic	Source of complexity	Cause
to higher durability and less maintenance [EV1. EV7]				sustainability embedded

Appendix Table C-7: Conflicting logics in PumpCo

Instance of logics	Service logic	market	Traditional production logic	Source of complexity		Cause	
				Internal	External	Means	Goal
Additive is chosen to cut lead-times – not for resource efficiency and requires the same amount of resources and energy as traditional manufacturing [PU8, PU10]	Limits to additive manufacturing		Spare parts	The company chooses the manufacturing technology			Service logic values short lead times over sustainability
Cost, technical feasibility, and lead-time are the drivers, sustainability never is as the customers have no interest, even though PumpCo has the capability to produce sustainable and efficient products. [PU4, PU7, PU10]	Cost is driver		Customer segments		Sustainability is never a driver for the customers		The values of the customers don't require sustainable production

Appendix Table C-8: Competing logics in PumpCo

Instance of logics	Service market logic	Traditional production logic	Source of complexity		Cause	
			Internal	External	Means	Goal
Additive manufacturing is not proven to save resources for PumpCo's applications and poses challenges to quality, IP protection, and customer relations. [PU8, PU9, PU10]	Limits to additive manufacturing	Spare parts	The company's operational challenges		Increased operational risk for unknown sustainability benefits	
The end-customer value the efficiency to reduce the operational cost, but EPC only want that much efficiency as they need to hold the capex low and not pay much more money for little more efficiency. [PU2, PU7]	Properties Cost is driver No market for sustainability	Customer segments Efficiency		End customer and EPC have conflicting interest		EPC value low CAPEX, end customer has additional interest in low OPEX
Internal processes such as value engineering do not consider sustainability aspects for the mere lack of interest, and the incentive to save cost in the process. [PU6]	Value engineering	Solution development	Company's internal decision to not consider sustainability			Company could consider sustainability but chooses to only focus on economics

Appendix Table C-9: Compatible logics in PumpCo

Instance of logics	Service market logic	Traditional production logic	Source of		Cause	
			Internal	External	Means	Goal
Customers environmental consciousness varies over different customer segments and geographies but added services reduces the need for replacement and maintains the efficiency. [PU7]	Sustainable technology Customer interest in sustainability	Spare parts Customer segments		Customers' choice to consider services and efficiency	The means to achieve efficiency led to spillover in sustainability	
Over 99% of the energy during the equipment's lifetime is consumed in the use phase, running the equipment at their ideal designed point and change the equipment when the requirements change result in the best efficiency. [PU1, PU2]	Retrofit Efficiency	Efficiency Customers value	Company strives to offer most efficient solution	Customers expect high efficiency	Efficiency reduces both cost and resources	
PumpCo has a division that delivers the services such as supporting repair and spare parts and upgrades pump equipment and give engineering assistance to service centres and field engineers to increase the lifetime and maintain efficiency of the equipment. [PU2, PU5]	Sustainable operations Development	Capabilities	Company's choice to provide after sales services		Means to provide service result as well in sustainable production logic	
In the development of solutions, sustainability through longevity and efficiency is relevant and recognised. [PU5]	Development	Solution development Co-development	Internal recognition of sustainability			Sustainability effects are valued
PumpCo has products installed that run for decades and offers retrofits, so the internals get retrofitted to match the changing requirements and maintain efficiency in the use phase. [PU2, PU4, PU7, PU9]	Recycling Retrofit	Retrofit	Company's choice to offer retrofit		Means to maintain efficiency result in reducing both cost and resources	

Appendix Table C-9: Compatible logics in PumpCo

Instance of logics	Service market logic	Traditional production logic	Source of complexity		Cause	
			Internal	External	Means	Goal
PumpCo has strong capabilities in the aftermarket and retrofits and repairs as well competitors' products. [PU5, PU8]	Sustainable operations	3 rd -party equipment	Company's choice to offer retrofit		Means to maintain efficiency result in reducing both cost and resources	
PumpCo has a reputation as one of the strongest players in the market with high quality, good reputation, reliable equipment, proactive and innovative development for which it extensively collaborates with their foundry suppliers to develop new products and ensure quality. [PU5, PU6, PU7]	Development Supplier Sustainable operations	Solution development Reputation	Company wants to keep their position in the market	Customers have certain expectation towards the company		Self-image and reputation of company
Additive manufacturing is great for spare parts when price customers are less cost sensitive and more interested in short lead times and eliminates the customers and PumpCo's requirement to have parts in stock and save on the physical resources and space for those spare parts. [PU8, PU9., PU10]	Additive manufacturing	Capabilities Spare parts 3 rd -party equipment		Customers require short lead times	Means to shorter lead times reduce resource use	
PumpCo uses additive manufacturing for the production of casting moulds to produce customised pumps with higher efficiency. [PU9, PU10]	Efficiency	Customer segments	Company drives co-development with suppliers		Means to increase efficiency led to reduction in resources required	
PumpCo has co-developed equipment for predictive maintenance and monitoring with their customers to see differences in the	Monitoring equipment	Remote monitoring		Customer co-development	Means to maintain efficiency result	

Appendix Table C-9: Compatible logics in PumpCo						
Instance of logics	Service market logic	Traditional production logic	Source of complexity		Cause	
			Internal	External	Means	Goal
operation of the equipment to see if the system runs ok and prevent further damage and maintain efficiency. [PU1, PU7]				driven by industry	in reducing both cost and resources	

Appendix D Drivers and challenges during value creation cycle

The occurrences of the types refer to the findings on barriers in Section 6.4 and drivers in Section 6.5.

Appendix Table D-1: Drivers and challenges during value creation cycle

Type	Description	Bundling	Offering	Evaluation	Adaption
Internal enabler	Financial independence				x
Internal enabler	Proximity within the organisation				x
Internal enabler	Flat rate maintenance contracts			x	
Internal enabler	Predictability of vehicle returns from customers				x
Internal enabler	Supplier audits				x
External enabler	Legislation supporting sustainability		x		
External enabler	WTO tenders allow smaller companies to bid		x		
External enabler	Sustainability becomes a hygiene factor/order qualifier		x		
External enabler	Certification helps to evidence sustainability in the tendering process	x			
Internal catalysts	ISO Certification and a role model function as a company act as an amplifier in the service-ecosystem			x	
Internal catalysts	Employees that are interested in sustainability are intrinsically driven to work for the company and need less supervision	x			
Internal catalysts	Start at some point to start learning				x
Internal catalysts	Take back scheme for all vehicles from all customers		x		
Internal catalysts	Technology and processes for predictive maintenance and reduction of pollution	x			
External catalysts	Products are widely used in public. That conveys a message that sustainability is possible		s		

Appendix Table D-1: Drivers and challenges during value creation cycle

External catalysts	The demands of one customer can increase the sustainability of an entire service ecosystem					x	
External catalysts	Differing needs in different markets are a driver for the business case for remanufacturing					x	
External catalysts	Increased exchange with suppliers helps to solve problems quicker						x
External catalysts	The innovation of processes is made publicly available to increase the impact on the companies concerns						x
Internal barrier	Culture					x	
Internal barrier	Capabilities		x				
Internal barrier	Ambidexterity				x		
External barrier	Market (No interest in sustainability, Fashion vulnerability and inferiority of products, Data concerns, Changes in consumer)				x		
External barrier	Service- Ecosystem		x				
External barrier	Technological (Rebound effects)		x				
External barrier	Regulatory (Law)						x

Appendix E Dissemination of Research

Conference paper	<p>Widmer, T.B., Prior, D.D., 2019. Institutional Isomorphism, Institutional Logics, and Organisational Fields: An Institutional Perspective on circular economy. In: Baines, T.S. (Ed.), Proceedings of the Spring Servitization Conference 2019. Aston University, pp. 1–9.</p> <p>Widmer, T., Tjahjono, B., Bourlakis, M., 2018. Defining value creation in the context of circular PSS. In: 10th CIRP Conference on Industrial Product-Service Systems, IPS2 2018, 29-31 May 2018, Linköping, Sweden. Elsevier, pp. 142–147.</p>
Conferences	<ul style="list-style-type: none"> • Presentation + Abstract: Widmer, T., Tjahjono, B., Bourlakis, M., Aktas, E., 2018. Operationalise sustainable development through circular economy principles. In: Circular Economy Disruptions – Past, Present and Future, 17-19 June 2018, Exeter, United Kingdom. • Presentation + Executive summary: Widmer, T., Tjahjono, B., Bourlakis, M., 2017. Defining circular Product-Service Systems: A business model approach. In: Proceedings of the Spring Servitization Conference: Internationalisation through Servitization, 15-17 May 2017, Lucerne Switzerland.
Other	<ul style="list-style-type: none"> • Presenting the progress of the research among the research consortium CIRCEUIT in biannual meetings • Presenting research to Cranfield Key Account Management and Strategic Sales (KAMSS) practitioner forum • Presenting at the Cranfield Doctoral Colloquium • Presenting to SME members of the Serbian Chamber of Commerce within the delivery of a workshop on circular PSS • Report as a project deliverable in the end report of the MSCA CIRCEUIT to the European commission
Publications in development	<ul style="list-style-type: none"> • Sustainable Customer Solutions: A resource integration perspective <ul style="list-style-type: none"> ○ Target journals: Journal of Business Research, Marketing Theory • Creating Value in Sustainable Customer Solutions: The Case of a EV Manufacturer <ul style="list-style-type: none"> ○ Target journals: Industrial Marketing Management