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Manufacturer's service relationships as a gateway to circular supply chains: merging insights from two literature fields

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ABSTRACT

Many manufacturers now have established service businesses to support the use of their products (created through servitization) and are now facing new pressures of sustainability and circularity. This research explores how relationships with supply chain actors may change for servitized manufacturers when implementing circular economy. Based on a structured literature review of two literature streams – servitization and circular economy – this paper provides an overview of existing concepts regarding the relationship dynamics in these settings. A framework is proposed detailing the relationships necessary for recovery, processing, and commercialization of circular products, parts or components when creating circular servitized supply chains. Specific directions for future work and wider avenues for future research are provided for creating circular servitized supply chains. The contributions of this research stem from the combining and contextualization of key insights from two literature streams and proposed conceptual framework for creating circular servitized supply chains.

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Structured literature review; servitization; circular economy; manufacturing

1. Introduction

The aim of this research is to integrate theoretical insights on supply chain relationships in servitization and circular economy contexts to enable servitized manufacturers, that is, firms offering 'fuller market packages' (Vandermerwe and Rada 1988) to respond to the pressures of sustainability posed by policies and regulations (EC 2011), as well as wider societal awareness (Ellen MacArthur Foundation 2015). New theoretical understanding is developed by combining the two literature streams of servitization and circular economy.

Servitization defines a transformation, in which many manufacturing firms 'offer fuller market packages or bundles of customer-focused combinations of goods, services, support, self-service, and knowledge' (Vandermerwe and Rada 1988, 314). These services often support the use phase of a product through preventive and corrective maintenance, spare parts exchange, operations support, product updates, and emissions monitoring (Kreye et al. 2022; Löfberg, Witell, and Gustafsson 2015; Oliveira and Roth 2012). Now, many of these companies face increasing pressures to implement circular economy (Lieder and Rashid 2016; Ünal and Shao 2019) in the form of regulations and societal awareness (Department for Environment, F. and R. A. (Defra), Department of Agriculture, E. and R. A. (DAERA), Welsh Government, & Scottish Government 2020; EC 2011; Ellen MacArthur Foundation 2015), which create significant impetus for manufacturing firms to shift their supply chains towards the circular economy. The circular economy defines 'the economy that

provides multiple value-creation mechanisms which are decoupled from the consumption of finite resources' (Ellen MacArthur Foundation 2015, 23). Implementing circular economy in manufacturing can enable material reutilization (Ünal and Shao 2019) and hence addresses increasing demands for environmental sustainability, including resource scarcity, environmental degradation, and climate change (De Angelis, Howard, and Miemczyk 2018; Velasco-Muñoz et al. 2021; Vljajic, Mijailovic, and Bogdanova 2018). It can also be a meaningful response to increasing supply uncertainty due to increasing frequency and extend of supply chain disruptions (Keller et al. 2021) by reducing waste at the end of product life cycles and hence the pressure on raw materials (MahmoumGonbadi, Genovese, and Sgalambro 2021). In addition, integrating sustainability concerns (Sroufe 2018) and the circular economy (Fernando, Shaharudin, and Abideen 2023; Moktadir et al. 2020) can create opportunities for growth and sustained business success.

Integrating insights from the two literature streams on servitization and circular economy regarding the supply chain relationships is not only motivated in practical pressures as described above but offers also significant theoretical value. Sustainability effects of servitization have been researched within the linear economy through extending product use phases or improving product designs (Doni, Corvino, and Bianchi Martini 2019; Szász and Seer 2018). In contrast, connections to circular economy implementation and specifically circular practices, such as reuse, remanufacture, and recycling are less clear.

Both literature streams – servitization and circular economy – have highlighted the role of supply chains in their implementation. Changing supply chain relationships is one of the core concerns of servitization with insights focusing on changing customer relationships, facilitating long-term collaborations and knowledge exchange (Alghisi and Saccani 2015; Kreye, Roehrich, and Lewis 2015; Löffberg, Witell, and Gustafsson 2015) and new supplier relationships through the inclusion of physical and digital elements in the service package (Saccani, Visintin, and Rapaccini 2014; Zhou et al. 2020). Existing reviews of servitization research have focused on these relational concerns (Eloranta and Turunen 2015; Zhang and Banerji 2017), including relationship governance and the means to facilitate collaboration and knowledge exchange (Kreye, Roehrich, and Lewis 2015; Nenonen, Ahvenniemi, and Martinsuo 2014). Similarly, the circular economy literature has highlighted the need for collaboration with new supply chain actors to allow for new material flows and to build close, trusting, and long-term relationships (Ahi and Searcy 2013; Koberg and Longoni 2019). Creating circular set ups requires not only the creation of new supplier connections and networks but also the close collaboration between (old and new) supply chain partners to realize the value-creation mechanisms, avoid waste generation within the system and reduce or eliminate the consumption of finite resources (MahmoumGonbadi, Genovese, and Sgalambro 2021). Thus, there seem to be strong similarities between the two literature streams, enabling conceptual integration. Based on these insights, this research therefore aims to answer the following research question:

How can servitized manufacturers leverage their supply chain relationships to implement circular economy for their serviced products?

This research hence responds to calls for more supply chain level investigations and multi-actor perspectives in the servitization literature (Eloranta and Turunen 2015; Raddats et al. 2019) and circular economy literature (Lieder and Rashid 2016; MahmoumGonbadi, Genovese, and Sgalambro 2021). Through a structured literature review (SLR) of the two streams, we aim to identify the specific conceptual and theoretical foundations to identify connections between them. Connecting the two literature streams requires a supply chain level perspective that analyses not only how dyadic relationships evolve but also how dynamic networks of partnerships develop and are governed. The SLR and combined analysis are the scope of this study. We propose a conceptual framework for circular servitized supply chains to conceptualize connection points between both literature streams and guide further work in this area. The conceptual framework details recovery, processing and commercialization concerns for a circular servitized supply chain and positions existing models and concepts within these supply chain activities.

The contributions of this work arise from the merging of insights from two distinct literature streams. This research first contributes to the servitization literature (Kreye 2017; Raddats et al. 2017; Saccani, Visintin, and Rapaccini 2014; Zhou et al. 2020) by contextualizing existing insights about relationships with different supply chain actors within the wider need to develop circular setups to reduce emissions

and dependence on raw materials (EC 2011; Ellen MacArthur Foundation 2015). Existing approaches to managing close and long-term relationships with supply chain actors are contrasted with circular economy requirements in terms of broad relationships with new supply chain actors. Creating circular servitized supply chains can thus be characterised as a step change for servitized manufacturers. The secondary contribution of this research is to the emerging field of circular supply chains (Farooque, Zhang, and Liu 2019; Nudurupati et al. 2022), demonstrating how some of the concerns currently described in the circular economy literature translate to servitized setups.

2. Method

To investigate the research question in detail, an SRL was conducted. An SLR offers the advantage of providing a rigorous basis for analyzing existing literature streams based on an unbiased selection of papers and a clear process of including and excluding existing works (Davis et al. 2014; Tranfield, Denyer, and Smart 2003). As both topics relevant for this research – servitization and circular economy – have individually received significant attention within the literature, an SLR offers an ideal approach for gaining an overview of core concepts and theoretical understanding within each field (Tranfield, Denyer, and Smart 2003) before merging them through identifying connection points (Webster and Watson 2002). An SLR is hence an appropriate method for this research. This research is hence theory elaboration in nature aimed at challenging and extending theory through applying it to a new context (Ketokivi and Choi 2014). In this study, we explore and expand primarily servitization research to the context of circular economy.

2.1. Data collection

To collect the relevant papers as the basis for this review, an initial search in various databases was performed to identify the best fit and coverage of the relevant databases (Davis et al. 2014). This search resulted in the decision to focus the main data collection on the Web of Science and Scopus. Additional searches were undertaken in ABI ProQuest, Ingenta and Science Direct, which largely resulted in the identification of duplicates and offered a much lower spread of the relevant academic literature. As a result, these databases were excluded from further data collection. Table 1 details the keywords and search strings used for the search for the two literature streams and the two databases Web of Science and Scopus. In the Appendix, Table A1 details the definitions and potential relationships between the search terms. Search terms were based on the literature, specifically other review papers on servitization (Raddats et al. 2019; Zhang and Banerji 2017) and circular economy (Calicchio Berardi and Peregrino de Brito 2021; Sudusinghe and Seuring 2022). The search focused on scholarly journals as outlets and included all such outlets listed in the search databases. In other words, we refrained from focusing on specific journals to avoid bias in the collected sample

Table 1. Data collection process literature.

		Web of Science*		Scopus**	
Search words		Number of entries	Total entries	Number of entries	Total entries
Servitization literature	Serviti* AND relation*	353	353	304	304
	AND dyad	4	357	3	307
	AND triad	8	365	8	315
	AND network	203	568	144	459
	AND supply chain	173	741	108	567
	AND partner	60	801	51	618
	AND customer	413	1,214	383	1,001
	AND supplier	133	1,347	103	1,104
	– Duplicates		–589		–412
	Total number of identified papers		757		692
	Service infusion AND relation*	29	29	21	21
	AND dyad	0	29	0	21
	AND triad	1	30	1	22
	AND network	17	47	11	33
	AND supply chain	7	54	5	38
	AND partner	2	56	2	40
	AND customer	44	100	42	82
	AND supplier	8	108	4	86
	– Duplicates		–43		–28
	Total number of identified papers		65		58
	Product-service system				
	AND relation*	93	93	126	126
	AND dyad	1	94	1	127
	AND triad	0	94	1	128
	AND network	50	144	79	207
	AND supply chain	50	194	48	255
	AND partner	19	213	23	278
	AND customer	203	416	228	506
	AND supplier	25	441	41	547
	– Duplicates		–217		–183
	Total number of identified papers		224		364
	Industrial services				
	AND relation*	30	30	69	69
	AND dyad	0	30	0	69
	AND triad	1	31	1	70
	AND network	14	45	26	96
	AND supply chain	9	54	13	109
	AND partner	6	60	11	120
	AND customer	39	99	91	211
	AND supplier	12	111	23	234
	– Duplicates		–53		–89
	Total number of identified papers		58		145
	Product-related services				
	AND relation*	0	0	12	12
	AND dyad	0	0	0	12
	AND triad	0	0	0	12
	AND network	1	1	3	15
	AND supply chain	0	1	2	17
	AND partner	0	1	0	17
	AND customer	3	4	20	37
	AND supplier	0	4	3	40
	– Duplicates		0		–15
	Total number of identified papers		4		25
	Servicification AND relation*	1	1	3	3
	AND dyad	0	1	1	4
	AND triad	0	1	0	4
	AND network	0	1	1	5
	AND supply chain	0	1	6	11
	AND partner	0	1	1	12
	AND customer	3	4	2	14
	AND supplier	0	4	0	14
	– Duplicates		–1		–6
	Total number of identified papers		3		8
	After-sales services				
	AND relation*	12	12	90	90
	AND dyad	0	12	1	91
	AND triad	0	12	0	91
	AND network	5	17	46	137
	AND supply chain	9	26	54	191
	AND partner	1	27	10	201
	AND customer	29	56	200	401
	AND supplier	8	64	42	443

(continued)

Table 1. Continued.

	Search words	Web of Science*		Scopus**	
		Number of entries	Total entries	Number of entries	Total entries
Circular supply chain literature	– Duplicates		–28		–169
	Total number of identified papers		36		274
	– Duplicates across the databases	–783			
	Total number of servitization papers	1,894			
	Analysis of title and abstract:		219 (Empirical papers)		
	Inclusion criteria: unit of analysis on supply chain/multiple network actors, relationships between organizations, empirical studies		19 (Review papers)		
	Exclusion criteria: conceptual/theoretical papers, unit of analysis on organization, technology focus				
	Circular supply chain				
	AND relation*	363	363	222	222
	AND dyad	3	366	3	225
	AND triad	4	370	2	227
	AND network	411	781	242	469
	AND partner	68	849	47	516
	AND customer	133	981	96	612
	AND supplier	138	1,119	112	724
	– Duplicates		–272		–168
	Total number of identified papers		847		556
	Circular economy				
	AND relation*	180	180	436	436
	AND dyad	1	181	3	439
	AND triad	1	182	1	440
	AND network	114	296	224	664
	AND supply chain	333	629	580	1,244
	AND partner	16	645	41	1,285
	AND customer	56	701	143	1,428
	AND supplier	46	747	77	1,505
	– Duplicates		–286		–430
	Total number of identified papers		461		1,075
	Reverse supply chain				
	AND relation*	13	13	32	32
	AND dyad	1	14	1	33
	AND triad	0	14	0	33
	AND network	29	43	56	89
	AND partner	2	45	5	94
	AND customer	15	60	61	155
	AND supplier	7	67	28	183
	– duplicates		–22		–45
	Total number of identified papers		45		138
	– Duplicates across the databases	–1341			
	Total number of circular supply chain papers	1,781			
	Analysis of title and abstract:		187 (Empirical papers)		
	Inclusion criteria: unit of analysis on supply chain/multiple network actors, relationships between organizations, empirical studies)		34 (Review papers)		
	Exclusion criteria: conceptual/theoretical papers, unit of analysis on organization, technology focus				

*All search terms in 'Topic'.

**All search terms in 'Title, abstract and keywords'.

(Webster and Watson 2002). This initial search gives an indication of the number of papers potentially relevant for this review. The full set of collected papers was then analyzed based on predefined inclusion and exclusion criteria (Table 1) to identify data sets of relevant papers. The inclusion criterion of 'unit of analysis on supply chain/multiple network actors' resulted in the exclusion of many papers from the original search. This process led to the identification of 219 papers (plus 19 review papers) for the servitization literature and 187 (plus 34 review papers) for the circular economy literature as the basis for this analysis.

The collected data sets spread across a relatively narrow span of publication years, as shown in Figure 1. Despite the relative maturity of the field of servitization (with articles emerging since 1989), papers focusing on the supply chain related unit of analysis have emerged relatively recently with few singular papers published before 2012. Since 2013, the number of relevant published papers has increased. In contrast, circular economy implementation is a relatively young field of investigation with relevant publications emerging since 2013 and increasing steadily.

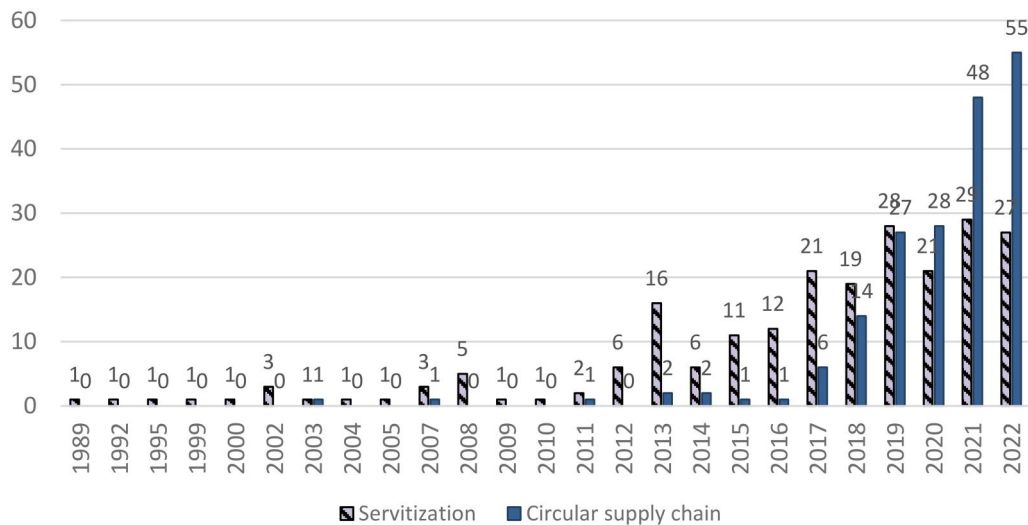


Figure 1. Distribution of publication year for two data sets.

The data set included a relatively wide range of journals. Figure 2 lists the main source journals that contained more than three papers relevant for this research. The full list of journals included in this analysis is presented in the Appendix (Table A2).

The methods applied in both literature streams were similar (Figure 3). The majority of empirical studies in both literature streams were conducted via case study or survey.

2.2. Data analysis

Data were analyzed following the process outlined by Webster and Watson (2002) to identify and connect core concepts within the two literature streams and to develop a conceptual framework of servitization for circularity. Initially, both data sets were analyzed separately. The starting point was the author-centric analysis of the individual papers, meaning that each paper's title and abstract were analyzed based on their specific contents (Webster and Watson, 2002). Abductive coding was applied by using both theoretically derived codes and inductively emerging codes (Table 2). Inductive descriptive codes were developed from the initial analysis of paper titles and abstracts based on their focus and main conclusions. Inductive coding was an iterative process, where initial descriptive codes were compared, and merged to achieve increasing levels of abstraction, resulting in the set of codes presented in Table 2.

The abductive codes were then connected via a concept map (Webster and Watson, 2002). These concept maps were initially constructed for each literature stream individually (Section 4.1) before connecting and merging them across the two streams. The identified review papers (Table 1) were used throughout the analysis to triangulate concepts and findings.

3. Results

This section focuses on the core insights of the two literature streams of servitization and circular economy implementation.

3.1. Servitization

The majority of the servitization papers (65%, 142 papers) investigated partnerships on dyad level, with 21% (46 papers) investigating networks, 5% (12 papers) supply chains and 9% (19 papers) triads. Here supply chains focus on vertical relationships, while networks include horizontal connections beyond the traditional supply chain conceptualization (Johnsen, Lamming, and Harland 2008). The predominant focus was on downstream relationships (Figure 4), especially with a (set of) customers (67%, 165 relationships in total) or intermediaries or distributors (5%, 13 relationships). Customers can include business customers in business-to-business (B2B) markets (Johansson, Raddats, and Witell 2019; Kamalaldin et al. 2020; Nenonen, Ahvenniemi, and Martinsuo 2014) and consumers in business-to-consumer (B2C) markets (Vaitinen and Nenonen 2018), the latter often involving networks of sharing products (Schaefers, Leban, and Vogt 2022). Most service offering focus on sole provision of services (71%, 156 papers) of the servitized manufacturer to their customer, with 38 papers (17%) describing collaborative service provision and 25 papers (12%) focusing on service integration from a set of partners or suppliers. The detailed combinations of supply chain actors and level of analysis in servitization papers is shown in Appendix (Table A3).

Differences in inductive codes of servitization arise from the supply chain actor(s) being investigated, as summarized in Table 3. In servitization, performance is determined in the customer relationship through the customer's perception of the received service quality (Karatzas, Johnson, and Bastl 2017; Kreye 2017; Nenonen, Ahvenniemi, and Martinsuo 2014; Perner and Skjølvik 2019; Shah et al. 2020; Tian et al. 2021). As one of the goals of servitization is to create lock-in situations with customers (Vandermerwe and Rada 1988), building long-term and stable relationships is a key component of the servitization literature, which has developed rich insights on managing collaboration. The predominant focus is on relationship governance to manage the flow of knowledge and material while considering relationship dynamics, including control and dependency (Benedettini and Neely

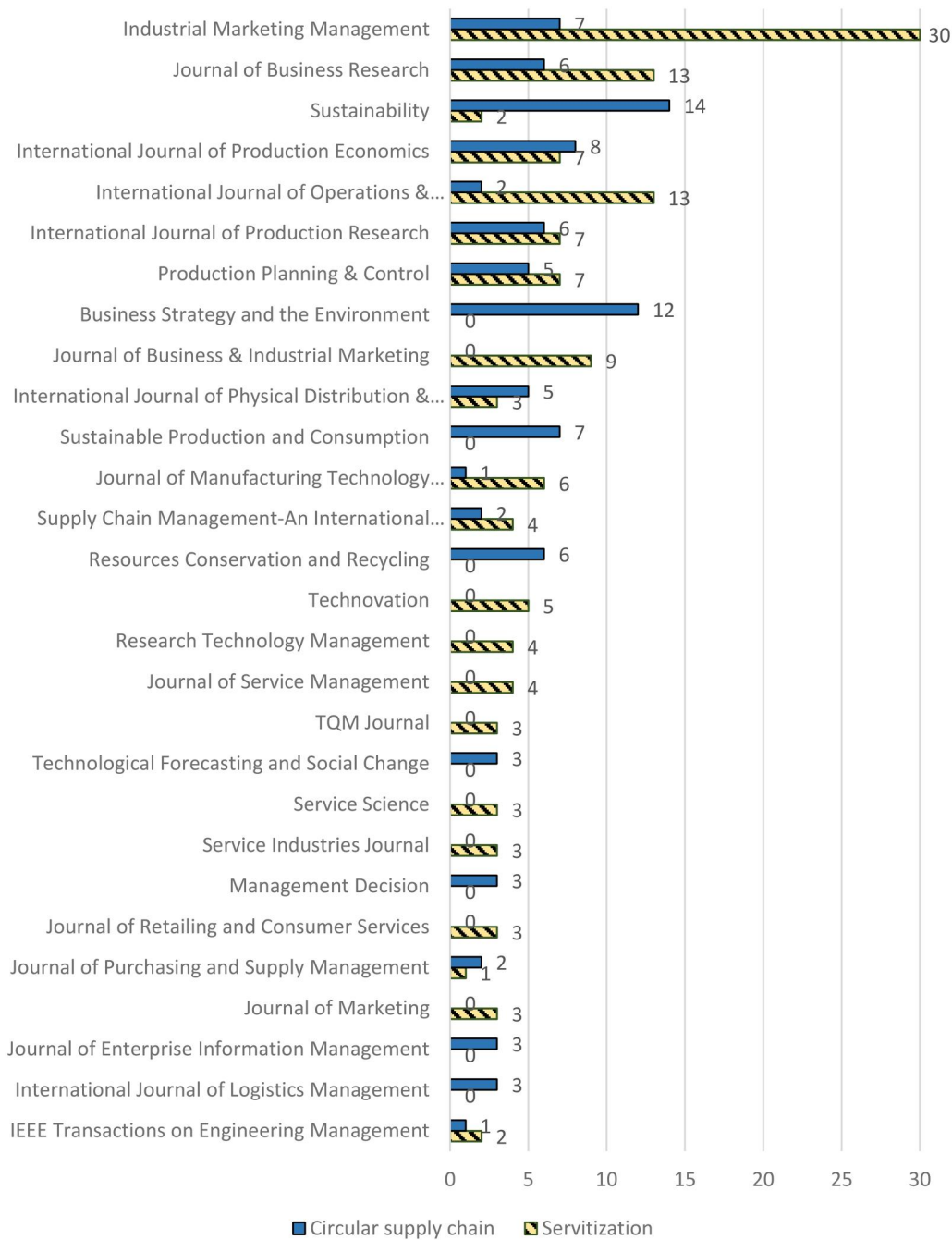


Figure 2. Main sources for analysed data set.

2019; Finne and Holmström 2013; Hedvall, Jagstedt, and Dubois 2019). Relationship governance includes contractual tools (Kreye 2022a; Li et al. 2022) and relational tools, including customer engagement (Holgado and Macchi 2023; Johansson, Raddats, and Witell 2019; Morgan, Anokhin, and Wincent 2019). The level of service complexity determines the extent of collaboration between provider and customer in downstream supply chain relationships (Chakkol et al. 2018; Kreye, Roehrich, and Lewis 2015). Performance improvements are created through connecting relationship governance and collaboration approaches (Bustinza et al. 2019; Weigel and Hadwich 2018). These rich insights show how organizations can benefit from continuous collaboration and manage the dynamic development of these relationships

(Chen et al. 2021; Kreye 2022b; Makkonen, Saarikorpi, and Rajala 2019).

Service delivery is also affected by other supply chain actors because the servitized manufacturer may integrate inputs from external partners or suppliers into the provision process (Story et al. 2017). While new relationships may need to be formed for this purpose, for example, to create digital elements to service offerings (Chen et al. 2021; Ramirez Hernandez and Kreye 2021; Tian et al. 2021), performance is achieved through supplier integration (Ayala, Gerstlberger, and Frank 2019) or collaboration (Kamalaldin et al. 2020; Tóth et al. 2022). In other words, long-term and close connections, and integration benefit upstream or horizontal relationships in servitization. Table 3 gives an overview of the

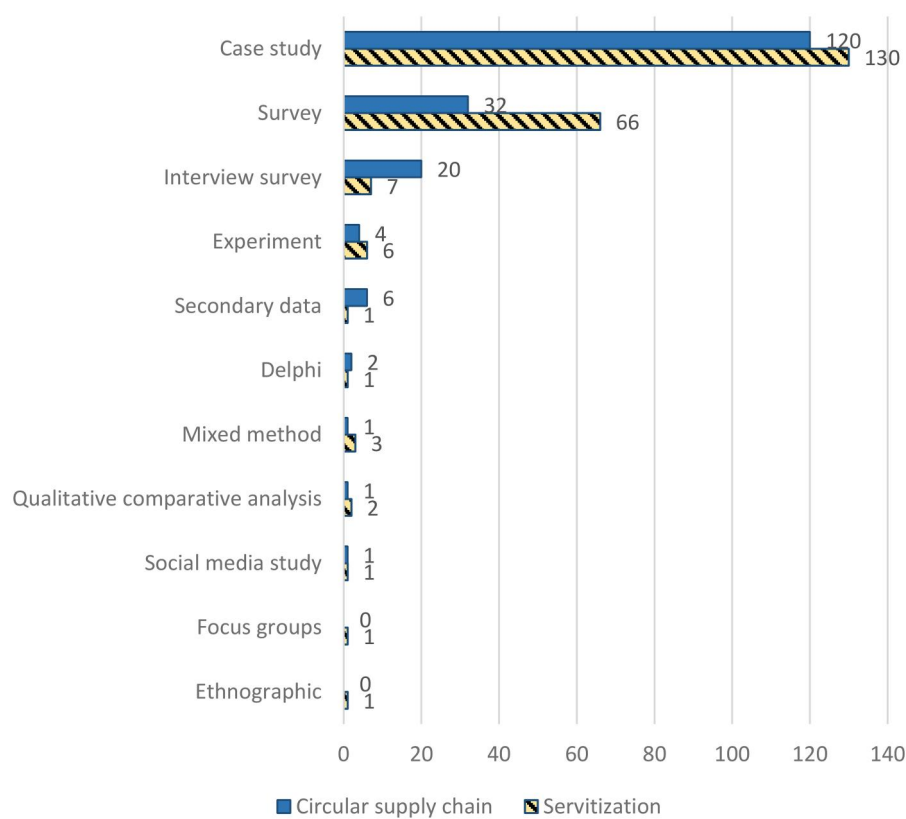


Figure 3. Applied methods for analysed data set.

Table 2. Codes for both literature streams.

	Servitization	Circular supply chain management
Deductive codes	<ul style="list-style-type: none"> Level of analysis (dyad, triad, supply chain, network) Supply chain partner (supplier, partner, customer, intermediary) Manufacturer role (sole provider, service integrator, collaborative provision) 	<ul style="list-style-type: none"> Level of analysis (dyad, triad, supply chain, network) Supply chain partner (supplier, partner, customer, receiver, finance, N/A)
Inductive codes	<ul style="list-style-type: none"> Capabilities (incl. eco-system capabilities, readiness) Customization Collaboration (incl. relationship governance, tensions, supplier integration, geographic proximity) Network configuration (incl. geographic closeness, supply chain design) 	<ul style="list-style-type: none"> Recovery (incl. barriers and drivers for accessing materials and products for circular practices and supply chain configurations) Processing (incl. barriers and drivers, collaboration and relationship formation) Commercialization (incl. barriers and drivers for commercializing circular products, information sharing and collaboration, relationship formation, and digital technology)

investigated connections with different supply chain actors, including the investigated concerns and insights.

3.2. Circular economy

Most of the papers analyzed on circular economy focused on the network (39%, 73 papers) or supply chain (33%, 61 papers) levels of analysis. Twenty-six percent (49 absolute) of papers investigated dyads. One percent (2 papers) of papers studied triads and Industrial districts respectively. A balanced view emerged of the studied supply chain relationships (Figure 5) with complex interrelationships amongst a multitude of supply chain actors, including non-traditional actors, such as finance institutes (Kahupi et al. 2021), government (Triguero, Cuerva, and Sáez-Martínez 2022), or brokers/platform providers (Ciulli, Kolk, and Boe-Lillegraven 2020). Some

of these relationships were even between individual organizations of a stakeholder group, including between suppliers and between partners and intermediaries. Twenty-one percent (39 papers) did not specify supply chain actors but remained on the supply chain or network level description.

Inductive codes focused on the flow of materials and products within the circular economy, which in turn determined the core concerns of investigations, as presented in Table 4. These focused on recovery, processing and commercialization of circular products, parts, or components. *Recovery* defines the ability of a focal company to obtain input into the circular economy through sourcing used products, components or parts that are potentially broken. It relates closely to issues typically described to reverse logistics (i.e. 'the processes of sending returned products back up the supply chain for resale, repair, reuse, remanufacture,

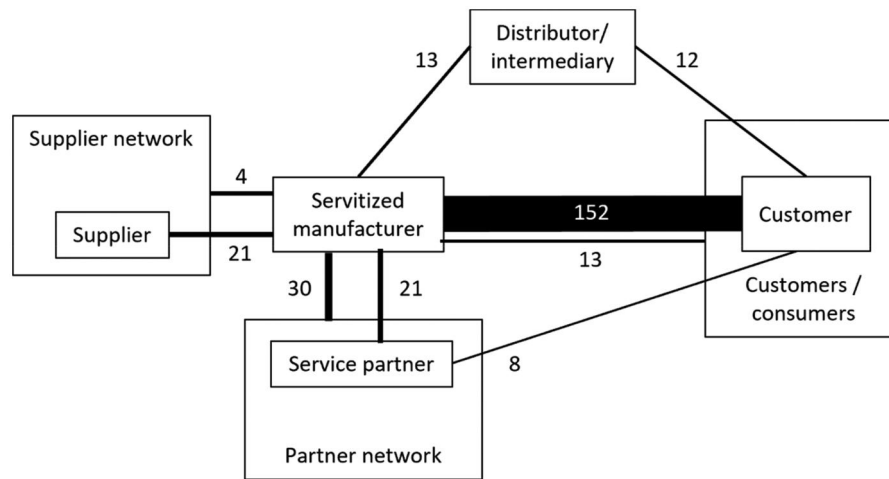


Figure 4. Investigated relationships with supply chain actors in servitization (the connections show the number of times relationships were included in papers as absolute numbers and represented through the thickness of the connections).

recycling or disposal' (Kreye 2023, 128)) or reverse supply chains (i.e. 'to reclaim and reprocess products' (Flygansvær, Dahlstrom, and Nygaard 2018, p.472)). Recovery concerns the supply of materials or products, which may be at the end of their use phase or appear as waste streams from other processes. Often, new relationships need to be formed (Dora 2020; Flygansvær, Dahlstrom, and Nygaard 2018; Kalverkamp 2018), which create new supply chain configurations (Sundgren, 2020; Vlajic, Mijailovic, and Bogdanova 2018). Here, the ability to build new relationships with existing supply chain actors is complemented by the emergence of new partner organizations to fill holes in circular supply chain setups (Ciulli, Kolk, and Boe-Lillegraven 2020; Veleva and Bodkin 2018). These new types of supply chain actors include distributors of waste streams (Sundgren 2020), brokers to match complex supply and demand streams (Ciulli, Kolk, and Boe-Lillegraven 2020) and logistics providers (Fernando, Shaharudin, and Abideen 2023; Gatenholm, Halldórsson, and Bäckstrand 2021). Focal organizations may aim to diversify supply and create multiple supply routes (Gebhardt, Spieske, and Birkel 2022).

Processing defines the steps needed to transform a used and potentially broken product, part or component into a circular product that can be reinstalled. The core concerns are the capabilities needed to engage in different circular practices (Xiong et al. 2022), including reuse (22 papers, 12%), remanufacture (14 paper, 7%) and recycling (44 paper, 24%). The performance of circular product flow is driven by the level of coordination between supply chain actors (Sepúlveda-Rojas and Ternero, 2020), while the level of physicality of the exchange (physical vs. non-physical) determines the importance of geographic proximity on the ability to collaborate (Dora 2020).

Commercialization describes the ability to (re)install a circular product at a customer site and therefore reintroduce it for use on its own or in existing machinery (Dey et al. 2022; Farooque, Zhang, and Liu 2019; Wang et al. 2020). Customer perception affects the demand for circular products, which determines the ability to market them (van Boerdonk, Krikke, and Lambrechts 2021; Wang et al. 2020). Circular products

often result in the creation of new supply chain structures (Sundgren 2020) and new markets (Vlajic, Mijailovic, and Bogdanova 2018).

3.3. Comparison literature streams of servitization and circular economy

Comparing the results of our analysis of the two literature stream reveals interested insights and key considerations in light of our research question. Specifically, we highlight x main points based on the similarities and differences between the two streams.

First, downstream relationships emerge as important in both streams. In servitization these downstream relationships are defined by richness of service-based interaction based on the type of service arrangement and its complexity. For example, less complex after-sales services require buyer-supplier relationships characterized by less frequent communication and less rich interactions (Legnani, Cavalieri, and Ierace 2009). In contrast, complex service arrangements, such as performance-based services require rich relationships with frequent communication and engagement (Batista et al. 2017; Datta 2020). In circular economy, downstream relationships determine the ability for recovery and commercialization. Here, it is less the richness of relationships but the existence of connections to relevant supply chain actors that is highlighted in the literature (Ciulli, Kolk, and Boe-Lillegraven 2020; Kahupi et al. 2021; Triguero, Cuerva, and Sáez-Martínez 2022).

Second, the supply networks described in both literature streams differ in terms of their levels of complexity. The CE literature describes complex inter-relationships of the focal company with a large set of supply chain actors, including partners, intermediaries, and their respective networks. Here, non-traditional supply chain actors (government, financial institutions etc.) as well as new supply chain actors (e.g. brokers, or collectors) affect these relationships and enable to fill capability gaps within the circular supply chain. The reason for this difference between the streams may be seen in the fundamental need for collaboration to enable circular

Table 3. Emerging areas of concern in servitization based on investigated supply chain actor(s).

Supply chain relationship	Supply chain structure	Key concerns and insights with exemplary references	No. of papers
Customer	Dyad	Relationship management and governance in the co-creation process (Holgado and Macchi 2023; Kreye 2017; Makkonen, Saarikorpi, and Rajala 2019), including interpersonal relationships (Raja et al. 2018), including efforts at knowledge sharing and collaboration throughout service provision (Schaefer, Ruffer, and Böhm 2021)	63
		Customer satisfaction and evaluation of delivered service in terms of service quality (Saidin et al. 2018) and performance outcomes (Zhang, Wei, and Gao 2023)	28
		Capability development and matching (Lenka, Parida, and Wincet 2017; Pereira et al. 2019; Raddats et al. 2017) to achieve sustained performance (Bustinza et al. 2015), including customer readiness for services (Toossi et al. 2013; Vaitinen and Martinsuo 2019)	23
		Relationship formation through targeting new customers with service offerings and influencing their behaviour in terms of product use (Kropp and Totzek 2020)	6
		Supply chain design in terms of strategic repositioning within the supply network through service provision (Gupta, Vääänen, and Khaneja 2016)	2
		Establishing new customer relationships (Alghisi and Saccani 2015) through services based on sharing economy, including customer acceptance of different value propositions (Rexfelt and Ornäs 2009) and customer satisfaction (Söderlund and Rosengren 2007)	11
+ Intermediary or partner	Triad	Collaborative provision of service between manufacturer and intermediary requires development of collaboration-specific capabilities (Story et al. 2017) and relationship governance tools (Karatzas, Johnson, and Bastl 2016; Kreye and Van Donk 2021) to manage tensions (Jamie et al. 2016; Tóth et al. 2022)	13
Partner	Dyad	Creation of strategic partnerships within partner network (Davies et al. 2021; Weigel and Hadwich 2018; Ziaee Bigdeli et al. 2018) creating dependency (Benedettini and Neely 2019) and improved performance, partner involvement during service development (Dain, Paché, and Calvi 2019)	12
		Management of collaboration within partner network, including knowledge sharing (Reim, Andersson, and Eckerwall 2023) and relationship governance (Sjödin, Parida, and Visnjic 2022)	20
		Identification and retainment of relevant partners for collaborative value delivery (Kapitan et al. 2022) and performance outcomes (Nenonen et al. 2014)	12
Supplier	Dyad	Change in upstream relationship based on servitization (Bastl et al. 2012; Saccani, Visintin, and Rapaccini 2014) or integrating suppliers into service development (Ayala, Gerstlberger, and Frank 2019; Ramirez Hernandez and Kreye 2021)	9
		Network configurations and embeddedness managing supplier contributions to services (Alghisi and Saccani 2015; Wagner, Jönke, and Hadjiconstantinou 2018) and supplier integration for service provision (Freije, de la Calle, and Ugarte 2022 Shah et al. 2020)	20
+ Customer	Network/supply chain		

economy (Dora 2020), while servitization is still dominated by a manufacturer acting as a sole service provider (see Section 3.1).

Third, there are similarities in the need to build rich horizontal relationships in the supply network. In servitization, this relates to partner engagement and integration of partner offerings, for example in digital service offerings (Kamalaldin et al. 2020). In CE, horizontal relationships are driven by the engagement with complex networks of partners and intermediaries as well as the relationships between these external stakeholder groups that drive horizontal relationships.

4. Discussion

Based on the insights from the two reviewed literature streams and their comparison, this section attempts to propose a framework (Figure 6) aimed at merging these insights.

We structure this framework based on the flow of reverse material streams, which emerged as a key concern in CE with the supply network being shaped around the recovery, processing and commercialization of circular products, parts or components. In this section, we discuss these three activities in the context of servitization based on the insights presented in Section 4.1.

4.1. Proposed framework for circular servitized supply chains

Servitized manufacturers need to *recover* used products, parts or components to enable reverse or circular supply chains. A meaningful starting point for them is their existing downstream relationships. In addition to direct customer contacts (Holgado and Macchi 2023; Perner and Skjølvsvik 2019; Pereira et al. 2019; Vandermerwe and Rada 1988), downstream relationships also include connections to service

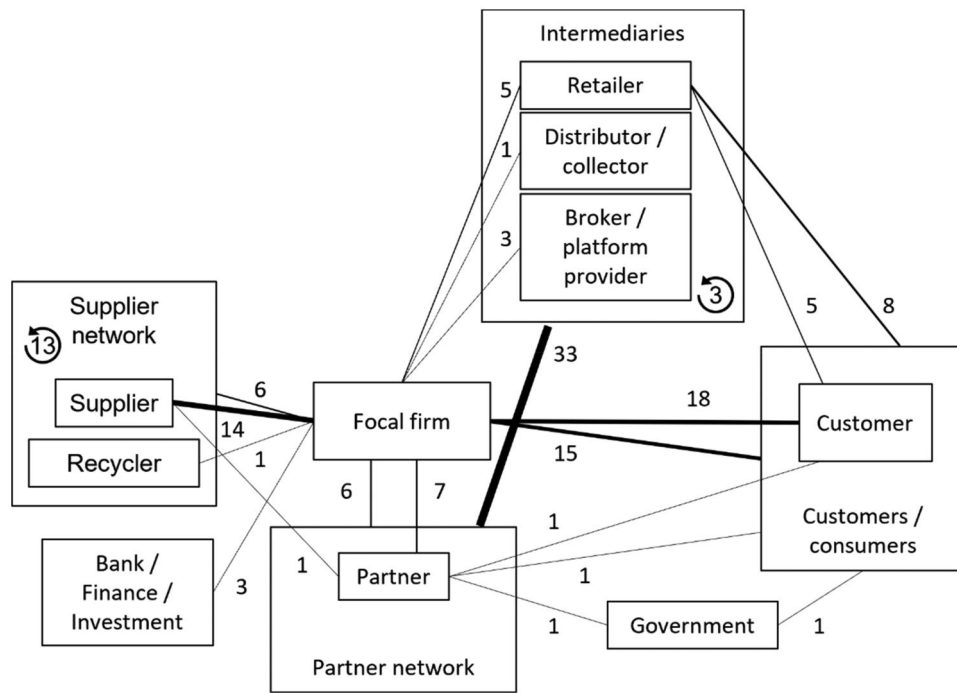


Figure 5. Investigated relationships with supply chain actors in circular economy (the connections show the number of times relationships were included in papers as absolute numbers and represented through the thickness of the connections).

partners for outsourced or joint service delivery (Eloranta and Turunen 2016; Karatzas, Johnson, and Bastl 2017) and distributors or intermediaries (Finne and Holmström 2013; Kreye and Van Donk 2021). These network relationships seem to form an important part of the circular economy set-up (Figure 5). Operational access is typically agreed upon in the contract and may depend on the level of service complexity (Batista et al. 2017; Eloranta and Turunen 2016; Kreye 2019; Morgan, Anokhin, and Wincent 2019). Service offerings of low complexity, such as after-sales services (Legnani, Cavalieri, and Ierace 2009) typically offer less possibility to interact with customers and access and recover used parts of components than complex offering such as performance-based services (Batista et al. 2017; Datta 2020) due to the closer and more multifaceted exchange of knowledge regarding product use and customer operations (Chakkol et al. 2018; Kreye, Roehrich, and Lewis 2015). In addition, recovery might be enabled performance-based arrangements as the servitized manufacturer often retains product ownership (Datta 2020; Pana and Kreye 2021). The importance of downstream relationships in both analysed literature streams suggests strong conceptual connections between servitization and CE implementation as well as a potentially good position that servitized manufacturers might have in driving and implementing circular supply chains by using existing connections and relationships.

Processing redirected out-of-use products, parts or components is a decision about specific circular practices such as remanufacturing and recycling (Dey et al. 2022; Fletcher, St Clair, and Sharmina 2021; Mokhtar et al. 2019). Some servitized manufacturers may already have the relevant capabilities and engage in circular practices (Priyono 2017). Other circular practices require establishing new relationships with new partners or new upstream supply chain actors. While

some investigations in servitization have uncovered the upstream and horizontal supply chain effects of service provision (Johnson and Mena 2008; Nenonen, Ahvenniemi, and Martinsuo 2014), more focused investigations around identification and relationship building with new suppliers and partners to implement circular practices require further work. This is evident in the much more complex arrangements of CE supply chains (Figure 5) in comparison to typical servitization studies (Figure 4). New relationships need to repurpose products through reuse, remanufacture, recycling and redirecting waste flows (Dey et al. 2022; Fletcher, St Clair, and Sharmina 2021; Mokhtar et al. 2019) and can include new types of supply chain actors, including brokers or other actors bridging holes in existing supply chain setups (Ciulli, Kolk, and Boe-Lillegraven 2020; Veleva and Bodkin 2018).

Commercialization of circular products depends on the ability to install them at customer sites and reintegrate them into a new use phase building again on downstream relationships. This may depend on customer perception and willingness (van Boerdonk, Krikke, and Lambrechts 2021; Wang et al. 2020). Like recovery, commercializing circular products may also connect to service complexity as complex service arrangements, such as performance-based services (Datta 2020; Pana and Kreye 2021) can enable the servitized manufacturers to retain control and hence the ability to install circular products, while also retaining the risk of their operation. These risks include the functionality and reliability of circular products (Franco 2017). However, commercialization of circular products, parts and components may also require expanding into new markets (Vlajic, Mijailovic, and Bogdanova 2018), such as new industry networks and new customer relationships.

Table 5 presents a summary of the considerations discussed in this section extending and detailing the conceptual

Table 4. Focus of circular supply chain papers based on emerging themes.

Emerging code	Investigated supply chain party	Key concerns and insights and exemplary references	No. of papers
Recovery	Customer + intermediary/partner	Formation of new supply chain connections with retailers and partners and collaboration for collecting products and materials and integrating them into reverse flows (Ciulli, Kolk, and Boe-Lillegraven 2020; Flygansv��r, Dahlstrom, and Nygaard 2018)	30
		Barriers to recovering materials and products for circularity due to lack of ownership (Ploeger et al. 2019) or channels for collecting and returning them (Pinho Santos and Proen��a 2022)	5
Processing	Partner(s) or supplier(s)	Barriers and drivers to implementing circular practices (such as remanufacturing or recycling), including the development of innovative practices (Tsolakis, Harrington, and Srai 2021), policy barriers (Kazancoglu et al. 2021) and pressure from and towards the industry environment (Zeng et al. 2017)	40
		Required collaboration and integration between supply chain actors to facilitate circular processing, such as recycling (Kumar Mangla et al. 2021), and enable knowledge exchange and traceability (Pal, Sandberg, and Paras 2019)	40
		Select suitable suppliers and partners and form new relationships for implementing circular practices (Castiglione and Fiore 2022)	34
		Performance of circular practices and circular products (Fernando, Shaharudin, and Abideen 2023)	6
		Barriers and drivers for circular supply chains in terms of commercialize, including customer perception of buying remanufactured products (Masi et al. 2018; Wang et al. 2020) and customer value creation (van Boerdonk, Krikke, and Lambrechts 2021)	19
Commercialization	Customer (+ intermediary)	Transparency through information sharing via product labelling (Aray et al. 2023; Nudurupati et al. 2022)	3
	Suppliers or partners	Formation of new supply chain structures for reverse flows (Gebhardt, Spieske, and Birkel 2022; Sundgren 2020) with new power structures and supply chain dynamics (Farooque, Zhang, and Liu 2019)	7
	Platform	Use of digital tools to share information and create markets for circular products (de Giovanni 2022)	2

framework presented in Figure 6. The framework offers a novel conceptualization of how servitized manufacturers can leverage their supply chain relationships to implement circular economy for their serviced products. It extends existing servitization frameworks, which typically focus on the relationships in linear supply chains, by adding considerations of reverse material flows. Each of the detailed supply chain activities is based on a distinct purpose within the circular setup and relates to the specific considerations of servitized manufacturers. The framework gives an integrated perspective and direction for investigations based on existing insights in the relatively mature field of servitization and emerging insights in the younger field of circular economy. Based on the discussions presented in this section, specific directions for future research aimed at establishing circular servitized supply chains are outlined in Table 5.

4.2. Managerial implications

This research – and particularly the proposed framework – gives clear directions for management actions in the context of creating circularity from existing servitized setups. Three managerial implications are highlighted here and summarized in Table 5 (Row 3). First, a meaningful starting point for circularity efforts is the access of servitized manufacturing firms to used or broken products, parts, or components through their service arrangements, enabling recovery. Managers can use existing service setups and customer relationships to explore the possibility of recovering used products, components or parts and redirecting them into the reverse supply chain. Suitable starting points when creating

circular supply chains from servitized arrangements are existing service offerings, which may need to be reevaluated in light of enabling recovery.

Second, managers need to explore the capabilities needed to process redirected products, parts or components through different circular practices (reuse, remanufacture, recycle etc.). The ability to develop these capabilities may depend on the specific industry sectors, creating differences in circular supply chain configurations. While some capabilities may already exist, managers need to explore whether these capabilities can be retained in-house or outsourced. Other capabilities may be developed and implemented or insourced. Examples here are inspection, reuse and remanufacture. In both cases, managers may seek to build relationships with new partners for capability development and management.

Third, managers in servitized manufacturing firms need to explore market opportunities for circular products. Existing service setups, especially if they are performance-based, offer a meaningful starting point for installing circular products in existing setups. Managers may focus on existing trusted customer relationships to jointly explore the opportunities and risks of installing circular products. Additionally, circular products may offer new markets and new customers, offering the possibility to further explore the potential benefits of a circular supply chain.

4.3. Future research agenda

The proposed conceptual framework for how servitized manufacturers can leverage their supply chain relationships to

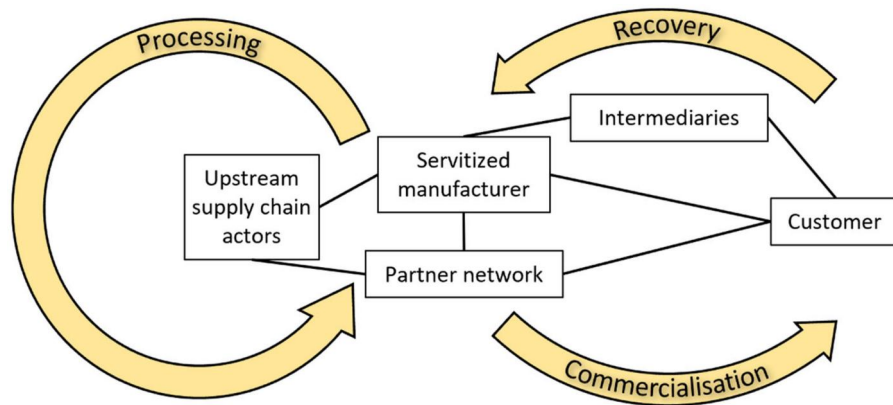


Figure 6. Conceptual framework for creating circular set ups from servitization.

Table 5. Considerations for recovery, processing and commercialization when creating circular supply chains from servitization.

	Recovery	Processing	Commercialization
Requirements in circular supply chains from servitization	Recovery to products, parts or components that are taken out of use through close, long-term downstream relationships with customers. Alternative access points through service partners, intermediaries, or distributors when services are provided in collaboration (triads or networks)	Determine relevant circular supply chain practice based on inspection and redirect product, part or component for reuse, remanufacture, recycling or similar	Commercialize circular products by determining new use in existing markets or creation of new markets
Managerial implications: questions for managers of servitized manufacturers to explore	<p>What access to you have to used or broken products, parts or components supporting recovery?</p> <ul style="list-style-type: none"> • What services do you provide for your products? • What happens to discarded parts or components after service repair? • How can these discarded parts or components be returned to upstream processes? 	<p>What process capabilities do you have?</p> <ul style="list-style-type: none"> • What is needed to inspect returned parts or components and decide on the state of the parts or components for reuse, remanufacturing, or recycling? • What does reuse, remanufacture or recycling look like for different parts or components? • What other supply chain actors have the relevant capabilities? What relationships do you have with them? 	<p>What (new) markets exist for circular products?</p> <ul style="list-style-type: none"> • Who are (potential) users of circular parts, components or products? • What would your product portfolio look like, if you included circular products, parts, or components? • How would you engage with the potential customers of circular parts, components or products?
Future research agenda – emerging areas for investigation	<p>Role of ownership rights and other contractually agreed terms in service contract enabling or inhibiting recovery of product-part of component.</p> <p>Role of rich, close, and long-term downstream relationships with customers (and intermediaries) affecting the ability to recover products, parts, or components based on the level of complexity of the service offering.</p> <p>Role of customer collaboration and communication transparency and data exchange regarding product use to determine recovery timing to retain maximum value based on the needs of circular practices</p>	<p>Ability to develop capabilities to implement circular practices (reuse, remanufacture, recycle, etc.) based on existing capabilities to manufacture or assemble products.</p> <p>Building relevant supply network relationships with partners and suppliers for circular practices to access relevant capabilities, including new supply chain actors, for, e.g. product remanufacturing</p> <p>Managing and governing relationships with relevant suppliers and partners providing access to circular practices over time.</p>	<p>Ability to commercialize circular products through testing and development within existing service arrangements based on existing customer relationships.</p> <p>Building and developing of relationships with supply chain actors to explore new markets accessible through circular products, including crossing of industry boundaries</p> <p>Role of contractually agreed terms and legal challenges for installing circular products, including warranty issues, technical functioning and product life spans.</p>

create circular supply chains for their serviced products points to important avenues for future research. The purpose of this subsection is to identify a potential research agenda for circular products in circular servitized supply chains in terms of recovery, processing, and commercialization.

Our research points towards two main concerns for recovery to end-of-life products, parts and components that require further research. Legal aspects of implementing circular economy may potentially have substantial impact on its

feasibility. For example, the contractual set up in different service offerings (based on their complexity) may affect the ability to redirect the product, component or part into the circular supply chain as complex services, where the customer purchases the service outcome rather than the product, may offer simpler set-ups for recovery. However, the contractual aspects of such agreements and their effect on the relationship require further investigation. Current descriptions of (service-based) relationship governance focus on the

downstream and thus typically have linear supply chain settings (Johansson, Raddats, and Witell 2019; Kamalaldin et al. 2020; Nenonen, Ahvenniemi, and Martinsuo 2014). Creating circular supply chains from these relationships may require changes in relationship governance and potentially a rethinking of relationship governance characteristics. Ownership rights (Ploeger et al. 2019) and agreed-upon levels of service complexity (Eloranta and Turunen 2016; Kreye 2019) exemplify contractual tools that need careful reconsideration in the context of circularity. Further concern may need to be given to relational governance as service customers turn into part or component suppliers in circular supply chains. Further theory needs to include these changes in the relationship dynamics between provider and customer and the wider network to identify how different kinds of relationships (transactional or relational, product centred or outcome centred, long-established or newly established, etc.) affect the ability to create circularity. Other supply chain configurations are also possible, particularly when the servitized manufacturer lacks direct customer access. For example, when service partners or intermediaries deliver the service to customers, this access may enable them to implement circular practices by developing the necessary capabilities. One example is a logistics provider that developed the capability to manufacture spare parts through additive manufacturing (Xiong et al. 2022). Such approaches would remove the servitized manufacturer from the focal point of a circular servitized supply chain and open the way for different, more complex setups. More research is needed on such different supply chain configurations and their effects for the service network.

The question of suitable products, parts or components extends to *processing* considerations in the proposed framework. Here, the cost of inspecting and processing returned products often determines which products are included in circular supply chains (Kalverkamp 2018). This determination considers the wear and tear of different products, parts or components experience when they are in use (Kalverkamp 2018), as well as design considerations (Gatenholm, Halldórsson, and Bäckstrand 2021). Future research hence needs to identify the types of current products, parts or components that can be included in circular supply chains and identify guidelines for designing future products, parts or components under the expectation that they will need to be included in such chains. A related question arises regarding a servitized manufacturer's need or willingness to conduct some of the operations of circular practices in-house or outsource them to external partners. This can refer to processes of logistics services to transport products, parts, or components between supply chain actors (Fernando, Shaharudin, and Abideen 2023; Kalverkamp 2018) or to build relevant capabilities locally (Dora 2020; Kreye and Van Donk 2021). This gives rise to the need to investigate existing circular practices within servitized arrangements. For example, further research needs to establish what circular practices are already implemented in servitized manufacturers. Similarly, further research needs to establish which circular practices can be implemented within the context of existing relationships. This research would give a meaningful understanding

of the basis for transforming existing servitized arrangements into circular supply chains.

When investigating the *commercialization* of circular products, parts or components, existing customers and customer relationships may be a good starting point. However, further consideration can be given to the creation of new markets or applications for circular products (Vlajic, Mijailovic, and Bogdanova 2018). New business models based on circular products may enable access to new markets and new customers, effectively extending the servitized manufacturer's business. In other words, circular servitized supply chains may result in new and potentially extended downstream constellations to market circular products. Further investigations need to consider the market relationships created through circular products. An important contrast between the servitization and circular economy literature concerns the depth or breadth of these relationships. The servitization literature highlights close and long-term relationships (Hedvall, Jagstedt, and Dubois 2019; Karatzas, Johnson, and Bastl 2017; Kreye 2017; Shah et al. 2020), suggesting that circular servitized supply chains may also rely on these deep relationships. In contrast, the circular economy literature has expressed the need to duplicate supply network connections (Gebhardt, Spieske, and Birkel 2022) and therefore create broad relationships. This contrast suggests a need to trade-off the advantages and disadvantages of deep and broad relationships for circular servitized supply chains.

4.4. Limitations

Several limitations apply to this study. First, the two studied streams of literature – servitization and circular economy – have thus far remained relatively separate. Only one duplicate entry was found across the two literature streams included in this study. While this may mean that existing servitization research lacks investigation into existing circular practices such as reuse, another interpretation can be the lack of explicitly connecting existing investigations to circularity. For example, descriptions in the servitization literature suggest that some providers already engage in circular practices of reusing or remanufacturing serviced products, parts, or components (Pana and Kreye, 2021; Priyono, 2017). Second, the proposed framework focuses on servitized manufacturers as the main lever for access to and commercialization of circular products. This framework was based on CE implementation around material reutilization (Ünal and Shao, 2019). However, circular supply chains could develop, excluding servitized manufacturers, and effectively compete with the considerations described in this research.

5. Conclusions

This research attempted to answer the question: How can servitized manufacturers leverage their supply chain relationships to create circular supply chains for their serviced products? Based on an SLR of the two literature streams of servitization and circular economy, we developed a conceptual framework for creating circular set-ups from servitization

based on material flow of related to recovery, processing and commercialization (Figure 6). As detailed in Table 5, each of these supply chain activities requires distinct considerations in terms of the formation and management of relationships with supply chain actors.

The theoretical contributions are distinct for the two reviewed literature streams. This research contributes to the servitization literature (Kreye 2017; Raddats et al. 2017; Saccani, Visintin, and Rapaccini 2014; Zhou et al. 2020) by contextualizing existing insights about relationships with different supply chain actors (within linear economy) to develop circular setups to reduce emissions and dependence on raw materials (EC 2011; Ellen MacArthur Foundation 2015). The existing strengths of servitized setups, such as close and long-term relationships (Hedvall, Jagstedt, and Dubois 2019; Shah et al. 2020) and access to customer operations (Kreye 2017; Raddats et al. 2017), are contrasted with the requirements of circular supply chains in terms of broad relationships (Masi et al. 2018; Nattassha et al. 2020) with new supply chain actors (Dora 2020; Flygansvær, Dahlstrom, and Nygaard 2018; Kalverkamp 2018). Creating circular servitized supply chains can thus be characterized as a step change for servitized manufacturers.

This research also contributes to the emerging field of circular supply chains (Farooque, Zhang, and Liu 2019; Nudurupati et al. 2022) by detailing the specific considerations in many manufacturing supply chains, which are characterized by servitized arrangements (Baines et al. 2017). Specifically, this research shows how some of the concerns currently described in the circular economy literature translate to servitized setups. By structuring emerging concerns around the supply chain activities of access, processing and commercialization, the proposed framework (Figure 6) can give direction for concerns in the wider circular economy literature.

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Notes on contributor



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Appendix

Table A1. Related concepts–definitions and relationship.

Servitization	Circular supply chain
Service infusion: 'The process of adding customer-centred services ... to a product-centric business model' (Ostrom et al. 2015; citing Zeithaml et al. 2014, xiv)	Circular economy: 'The economy that provides multiple value-creation mechanisms which are decoupled from the consumption of finite resources' (Ellen MacArthur Foundation 2015, p. 23)
Product-service system: 'Consisting of tangible products and intangible services designed and combined so that they jointly are capable of fulfilling specific customer needs' (Tukker, 2004, 246)	Reverse supply chains: 'Design, plan, and control the reverse supply chains that process returned products from the customer, recover their value, and use or sell them again' (Blackburn et al. 2004, p. 6)
Industrial services: Services provided to business customers, including activities of '(1) maintenance and repair services, e.g. equipment repair, janitorial services, usually supplied under contract; and (2) business advisor services e.g. legal, accounting, advertising, management consulting, typically new task-buying situations' (Boyt and Harvey 1997)	
Product-related service:	
Servicification: 'the emphasis, when looking at offerings, is no longer on the production process that historically created them as "outputs", but in their property as inputs in the value-creating process of the customer system'. (Normann, 2001)	
After-sales services: Services 'offered as part of consumer durables or industrial products' (Kasper and Lemmink 1989, 200)	

Table A2. Source titles included in analysis (sorted alphabetically).

	Servitization	Circular SC	Total
Academic Journal of Interdisciplinary Studies	1	0	1
Advances in Services Marketing and Management	1	0	1
African Journal of Business Management	1	0	1
African Journal of Economic and Management Studies	1	0	1
Agriculture and Food Security	0	1	1
Amfiteatru Economic	0	1	1
Asia Pacific Business Review	1	0	1
Batteries-Basel	0	1	1
Benchmarking-An International Journal	0	2	2
Biomass and Bioenergy	0	1	1
British Food Journal	1	0	1
Brussels Studies	0	1	1
Building Research and Information	0	1	1
Business Strategy and the Environment	0	12	12
California Management Review	2	0	2
Chemical Engineering Transactions	0	1	1
CIRP Annals – Manufacturing Technology	1	0	1
CIRP Journal of Manufacturing Science and Technology	1	0	1
Cleaner Logistics and Supply Chain	0	2	2
Contaduria y Administracion	1	0	1
Corporate Social Responsibility and Environmental Management	0	1	1
Design Journal	1	0	1
E a M: Ekonomie a Management	1	0	1
Electronic Markets	1	0	1
Engineering Management Journal	1	0	1
European Journal of Management and Business Economics	0	1	1
European Journal of Operational Research	0	1	1
European Management Review	0	1	1
Facilities	0	1	1
Global Journal of Flexible Systems Management	1	0	1
IEEE Transactions on Engineering Management	2	1	3
Industrial Marketing Management	30	7	37
Information and Management	1	0	1
Information Systems Journal	1	0	1
Innovation-Organization & Management	1	0	1
International Journal of Applied Business and Economic Research	1	0	1
International Journal of Business and Globalisation	1	0	1
International Journal of Business Data Communications and Networking	1	0	1
International Journal of Business Environment	2	0	2
International Journal of Business Performance and Supply Chain Modelling	0	1	1
International Journal of Computer Integrated Manufacturing	1	0	1
International Journal of Engineering Business Management	1	0	1
International Journal of Integrated Supply Management	0	1	1
International Journal of Logistics Management	0	3	3
International Journal of Logistics-Research and Applications	1	0	1
International Journal of Management and Decision Making	0	1	1
International Journal of Management Science and Engineering Management	1	0	1
International Journal of Networking and Virtual Organisations	1	0	1
International Journal of Operations & Production Management	13	2	15
International Journal of Physical Distribution & Logistics Management	3	5	8
International Journal of Product Lifecycle Management	2	0	2
International Journal of Production Economics	7	8	15
International Journal of Production Research	7	6	13
International Journal of Productivity and Performance Management	0	1	1
International Journal of Productivity and Quality Management	1	0	1
International Journal of Quality & Reliability Management	1	0	1
International Journal of Quality & Service Sciences	2	0	2
International Journal of Research in Marketing	1	0	1
International Journal of Service Industry Management	1	0	1
International Journal of Services and Operations Management	2	0	2
International Journal of Social Ecology and Sustainable Development	0	1	1
International Journal of Supply Chain Management	2	0	2
International Journal of Sustainable Engineering	0	1	1
International Journal of Technology, Policy and Management	0	0	1
International Journal on Interactive Design and Manufacturing	1	0	1
International Marketing Review	1	0	1
International Review of Retail, Distribution and Consumer Research	1	1	2
Investigaciones Regionales-Journal of Regional Research	2	0	2
Journal of Advances in Management Research	1	0	1
Journal of Applied Structural Equation Modeling	1	0	1
Journal of Business & Industrial Marketing	9	0	9
Journal of Business Ethics	1	1	2
Journal of Business Research	13	6	19
Journal of Business-to-Business Marketing	1	0	1

(continued)

Table A2. Continued.

	Servitization	Circular SC	Total
Journal of Cleaner Production	5	43	48
Journal of Consumer Policy	0	1	1
Journal of Distribution Science	1	0	1
Journal of Enterprise Information Management	0	3	3
Journal of Entrepreneurship in Emerging Economies	0	1	1
Journal of Environmental Management	0	1	1
Journal of Fashion Marketing and Management	0	1	1
Journal of Global Marketing	1	0	1
Journal of Industrial and Management Optimization	0	1	1
Journal of Industrial Ecology	0	1	1
Journal of Industrial Engineering and Management	1	0	1
Journal of Manufacturing Systems	1	0	1
Journal of Manufacturing Technology Management	6	1	7
Journal of Marketing	3	0	3
Journal of Marketing Management	1	0	1
Journal of Purchasing and Supply Management	1	2	3
Journal of Quality in Maintenance Engineering	1	0	1
Journal of Relationship Marketing	1	0	1
Journal of Retailing and Consumer Services	3	0	3
Journal of Risk and Financial Management	1	0	1
Journal of Science and Technology Policy Management	1	0	1
Journal of Service Management	4	0	4
Journal of Service Research	1	0	1
Journal of Service Theory and Practice	1	0	1
Journal of Services Marketing	1	0	1
Journal of Strategic Marketing	0	1	1
Journal of Strategy and Management	0	1	1
Journal of Systems Science and Systems Engineering	1	0	1
Journal of World Business	1	0	1
Learning Organization	1	0	1
Logforum	0	1	1
Logistics-Basel	0	1	1
M&SOM-Manufacturing & Service Operations Management	0	1	1
Management and Production Engineering Review	1	1	2
Management Decision	0	3	3
Management of Environmental Quality	0	1	1
Managing Service Quality	1	0	1
Micro and Macro Marketing	0	1	1
MIS Quarterly	1	0	1
Nature Food	0	1	1
Operations and Supply Chain Management-An International Journal	1	0	1
Operations Management Research	0	1	1
Production and Operations Management	1	0	1
Production Planning & Control	7	5	12
Psychology & Marketing	1	0	1
Quality Technology and Quantitative Management	1	0	1
R & D Management	2	0	2
RAE-Revista de Administracao de Empresas	0	1	1
Research in Transportation Business and Management	1	0	1
Research Policy	0	1	1
Research Technology Management	4	0	4
Resources Conservation and Recycling	0	6	6
Scandinavian Journal of Management	0	1	1
Service Industries Journal	3	0	3
Service Science	3	0	3
Services Marketing Quarterly	1	0	1
Social Responsibility Journal	0	1	1
South Asian Journal of Business and Management Cases	0	1	1
Strategic Change-Briefings in Entrepreneurial Finance	1	0	1
Supply Chain Forum	1	0	1
Supply Chain Management-An International Journal	4	2	6
Sustainability	2	14	16
Sustainable Production and Consumption	0	7	7
Technological Forecasting and Social Change	0	3	3
Technology in Society	1	0	1
Technovation	5	0	5
Total Quality Management & Business Excellence	1	0	1
TQM Journal	3	0	3
Transportation Research Part E-Logistics and Transportation Review	0	2	2
Universia Business Review	1	0	1
Waste Management	0	1	1

Table A3. Combination of level of analysis and investigated relationships.

			Count
Servitization	Dyad	Customer	120
		Partner	12
		Intermediary	1
		Supplier	9
	Triad	Customer – partner	7
		Customer – partner network	1
		Customer – intermediary	10
		Between customers	1
		Customers/Consumers	6
	Network	Partners	25
		Customer – partner network	2
		Customers – partner network	3
		Customer – supplier	2
		Customers – supplier network	2
		Customers – intermediary	2
		Supplier – partner	1
		Supplier – intermediary	1
		Supplier network	2
		Customer – supplier	8
		Supplier network	4
	Supply chain		
Circular economy	Dyad	Customer	18
		Retailer	4
		Broker/platform/entrepreneur	3
		Partner	6
		Retailer – consumer	4
		Supplier	14
	Triad	Retailer customer	1
		Partner - customer	1
	Industrial district	Partner network	2
		Bank/finance institute	3
	Network	Consumers/Customers	12
		Partners – intermediaries	33
		Government – consumers	1
		Intermediaries	2
		Partner – consumers	1
		N/A	13
		Partner – government	1
		Retailers – consumers	2
		Supplier – partner	1
		Suppliers	1
		Suppliers – focal firm	1
	Supply chain	Collector	1
		Customers	3
		Intermediary – customers	4
		Retailers	1
		Recycler	1
		N/A	26
		Partners	6
		Supplier – customer	5
		Suppliers	12
		Retailer - consumers	2