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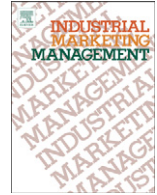
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Platforms in service-driven manufacturing: Leveraging complexity by connecting, sharing, and integrating



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ABSTRACT

Service-driven manufacturing firms often rely on networks in service operations; however, in order to leverage the network approach, firms must address the challenges of managing and orchestrating complex inter-organizational relationships. In this study, we identify how companies aim to leverage network-related complexity in their operations instead of trying to reduce complexity. We show how platform approaches have been used and could be used in this setting to assist in the flexible externalizing of resources and capabilities, and to provide structure for network orchestration. Although limited to the case-study setting, this study provides a rationale for using platform approaches in a service-driven manufacturing context, demonstrating how all of the identified logics have a special role in value creation in service networks.

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1. Introduction

Leveraging complex service-driven relationships is believed to provide a competitive advantage for manufacturers (Gebauer, 2008; Gebauer, Gustafsson, & Witell, 2011; Kindström & Kowalkowski, 2009; Mathieu, 2001; Neu & Brown, 2005). A transition from the business model toward a customer relationship orientation, results-driven solutions and customized value offerings, has been defined as “servitization” (Baines, Lightfoot, Benedettini, & Kay, 2009; Vandermerwe & Rada, 1989; Wise & Baumgartner, 1999). Research has shown that sufficient service scope and agility can be achieved by developing solution networks (Gebauer, Paiola, & Saccani, 2013; Henneberg, Gruber, & Naudé, 2013; Jaakkola & Hakanen, 2013; Kowalkowski, Witell, & Gustafsson, 2013; Matthysens & Vandenbempt, 2010; Spring & Araujo, 2009). By building value constellations and using inter-firm resource complementarities, organizations attempt to overcome internal challenges (Baines et al., 2009; Brax, 2005; Martinez, Bastl, Kingston, & Evans, 2010; Tukker & Tischner, 2006; Turunen & Toivonen, 2011) and create solutions that reach beyond their resources and competences (Agarwal & Selen, 2009; Rusanen, Halinen, & Jaakkola, 2014; Windahl & Lakemond, 2006). Originally described as an “imaginative”

(Mathieu, 2001, p. 446) idea in the manufacturing context, the collaborative option has become increasingly appealing.

A network approach generates complexity emerging from the networked inter-firm structures. As a network quickly expands and grows, it becomes difficult to navigate. Research has shown that manufacturers struggle with orchestrating and managing solution networks to provide the intended benefits (Den Hertog, Van Der Aa, & De Jong, 2010; Gebauer et al., 2013; Kindström, Kowalkowski, & Sandberg, 2012; Spring & Araujo, 2009). Integration and control focused models (Davies, Brady, & Hobday, 2007; Windahl & Lakemond, 2006) as well as modularization (Pekkarinen & Ulkuniemi, 2008) have been proposed as means to reduce complexity of the inter-firm configurations. However, rigid structures seem to reach their limits because, in the solutions context, complex and diverse customer needs often require great agility and broad network involvement (Agarwal & Selen, 2009; Kowalkowski, Kindström, Alejandro, Brege, & Biggemann, 2012). Research has been scarce on showing models in which complexity of the network relationships could be not only reduced, but also used to the benefit of the service-driven manufacturer.

This study explores service network orchestration with a platform approach that has been proven to provide a means of inter-firm relationship management, especially in complex and agile environments (e.g., Gawer, 2009). The platform approach offers a point of control and rent extraction for industries (Baldwin & Woodard, 2008). Current research has focused on platforms in the context of orchestrating industrial ecosystems and complementarities (Jacobides, Knudsen, & Augier,

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2006; Teece, 2007), fitting well in the service environment where agile inter-firm networks are called for (e.g., Iansiti & Levien, 2004). Researchers have considered opportunities that platforms might offer in the service and manufacturing context (Brax & Jonsson, 2009; Kindström & Kowalkowski, 2009). However, the majority of this research has limited empirical evidence, and most importantly, only a few theoretical links have been made between servitization, solution networks, and existing knowledge on platforms as an approach to deal with the network. Thus, platforms have played a supporting role and have not been analyzed in detail from the perspective of services.

We aim to understand how platform strategies help companies benefit from the complexity inherent in service and solution networks in the manufacturing context. In this setting, we identified five mechanisms and three distinct logics that drive a platform approach, all of which are based on different means of leveraging the complexity. Our research addresses the gap in the literature related to operations management in the service network context by answering the following question: *How do service-driven manufacturing companies construct platforms in order to leverage network complexity?* Our findings indicate that the platform approach might offer a means of orchestrating service and solution networks varying in degree of openness, involvement, and control over the innovation and value creation.

2. Theoretical background

To establish the theoretical base, we will briefly outline the discussion on manufacturers' transition from product to solution business, focusing on innovation and delivery of services in inter-organizational networks. We discuss how platform approaches have been used in previous research with regard to abstract platform discourse and context-dependent servitization studies.

2.1. Servitization and inter-organizational networks

Various authors argue that manufacturers can create sources of competitive advantage through a service-driven relationship orientation and customized value offerings (Eloranta & Turunen, 2015; Gebauer, 2008; Gebauer et al., 2011; Kindström & Kowalkowski, 2009; Mathieu, 2001). The profitable transformation from a transactional business model to complex solutions is not straightforward because new capabilities, business models, and processes are required (Baines et al., 2009; Brax, 2005; Martinez et al., 2010). Organizations also face internal challenges and organizational inertia (Tukker & Tischner, 2006; Turunen & Toivonen, 2011).

Research has demonstrated how the network approach can help overcome the capability and resource requirements related to this shift (Agarwal & Selen, 2009; Henneberg et al., 2013; Kowalkowski et al., 2013; Rusanen et al., 2014; Windahl & Lakemond, 2006). The network approach acknowledges external resources and capabilities (Teece, 2007) that allow the network to support the tasks that surpass the company's own abilities (Agarwal & Selen, 2009; Rusanen et al., 2014; Windahl & Lakemond, 2006). Companies facilitate the creation of so-called service systems (Maglio, Vargo, Caswell, & Spohrer, 2009; Vargo & Lusch, 2011) in which various structures are used for orchestration; along with traditional service partnering, system- (Hobday, Davies, & Prencipe, 2005) and integrator-based models (Davies et al., 2007; Windahl & Lakemond, 2006) have gained attention.

The network approach alone does not guarantee success in the service orientation as the networked mode of operation creates complexity. The complexity-related challenges lie primarily in network orchestration (Bikfalvi, Lay, Maloca, & Waser, 2013) as the supply base (Choi & Krause, 2006) and industry structures (Hobday et al., 2005) become more diverse, changing the actor roles (Henneberg et al., 2013) and complicating the power structures of the market (Finne, Turunen & Eloranta, 2015; Neu & Brown, 2005). The supply-base complexity is seen as the result of the increasing number of suppliers, the degree of

differentiation among them, and the level of inter-relationships among actors (Choi & Krause, 2006). Industry structure and relationship diversity are results of vertical disintegration (Hobday et al., 2005). The multiplicity of actor roles is, according to Henneberg et al. (2013), a natural continuation as the networked actors do not have static roles but might operate in different and even overlapping positions at any one point in time (Ramirez, 1999).

2.2. Orchestrating inter-organizational networks with platforms

Research has recognized a number of ways to cope with the complexity originating from service networks. Studies on servitization have identified the capabilities required for network operations (e.g., Den Hertog et al., 2010; Gebauer et al., 2013; Hobday et al., 2005; Kohtamäki, Partanen, Parida, & Wincent, 2013; Kowalkowski et al., 2013; Spring & Araujo, 2009, 2013; Windahl & Lakemond, 2006) as well their relative importance in different network structures (e.g., Gebauer et al., 2013). More specifically, the abilities to manage, use, and exploit inter-organizational relationships (Windahl & Lakemond, 2006), sense opportunities, and restructure delivery and innovation (Kindström et al., 2012) as well as co-produce in the networks are crucial for success (Den Hertog et al., 2010; Kohtamäki et al., 2013). In addition, companies that organize solution networks need to be virtuosos in operations management of the networked environment (Spring & Araujo, 2009, p. 459).

Even if the capabilities for networked services and solutions have been identified, there is scarce research on the operational mode that could be applied in the manufacturers' service network context. However, especially in information and communications technology (ICT)-related studies, platforms have been suggested to serve as a mode that allows point of control and rent extraction (Baldwin & Woodard, 2008). Platform strategies have been proven to fit well in environments where agile inter-firm networks are needed to provide a competitive advantage (e.g., Iansiti & Levien, 2004). In addition, there has long been a strong interest in platforms in contexts where high-variety strategies are needed (e.g., Sawhney, 1998), offering an interesting link to complex service settings that demand agility and highly customized solutions.

Platforms can be applied in various levels of organization. The original aim of platforms was to accommodate a firm's increasing offering variety without overly complex internal structures (Sawhney, 1998). On the offering level, platform products constitute product families that allow easy modification through the addition, removal, or substitution of features (Meyer, Tertzakian, & Utterback, 1997; Sawhney, 1998; Wheelwright & Clark, 1992). On the organizational level, platforms have become a widely used mode for orchestrating and leading co-specialized business ecosystems (Gawer & Cusumano, 2002, 2008; Iansiti & Levien, 2004; Jacobides et al., 2006; Teece, 2007). The newest paradigm has shifted the focus of platforms from the offering and organizational focus toward the leveraging of the complex relationship structures of inter-firm networks (Gawer, 2009). So-called supply chain platforms form a common structure (interfaces and subsystems) of derivative products to be developed by several actors within the chain. In contrast, industry platforms and two-sided markets are used in an industrial ecosystem approach (Gawer, 2009). Two-sided markets have become specifically associated with products, services, firms, and institutions that mediate transactions among a number of actors in a business ecosystem (Eisenmann, Parker, & Van Alstyne, 2006; Evans, 2003; Hagi, 2009; Rochet & Tirole, 2003; Suarez & Cusumano, 2009). The intention is to bring together groups of users, and with a platform structure, provide the infrastructure and rules that facilitate transactions between parties. Industry platforms, in turn, serve primarily as a foundation on which other companies build complementary products, services, and technologies, thereby increasing the value of the actors in the platform via the direct and indirect effects of the network. In practice, the modern view of platforms usually materializes in the form of

ICT environments (e.g., websites, applications, or virtual spaces), technological architectures (reusable components), or even physical spaces in which different actors can cooperate and on which they can construct their own business models (Evans, 2003).

2.3. Current views on servitization and platforms

The servitization literature has taken a variety of approaches toward platform thinking, with the central paradigm being a firm with a strong integrator role, aiming to find modular structures in order to improve customer orientation but avoid organizational complexity. The focus has been mainly on reducing the organizational complexity yet keeping required offering variety in order to provide customized value offerings for the customers. Pekkarinen and Ulkuniemi (2008) define service platforms from the internal perspective as a systematic way for a company to develop, organize, and provide modularized service offerings. Windahl and Lakemond (2006) emphasize the role of “core capabilities and platforms that form the basis for the integrated solution offerings” (p. 808), referring not only to products but also to a company’s knowledge and capabilities as a platform for service development. Brax and Jonsson (2009) and Kindström and Kowalkowski (2009) show how these aims are converted into practical implementations in the form of service delivery platforms.

Lately, the service context-specific platform discussion has shifted from reducing and managing service-originated complexity to leveraging the complexity of service networks. Palo and Tähtinen (2011) call for new innovative ways to cooperate, share resources, and communicate, referring to “platforms.” Similarly, Den Hertog et al. (2010) argue that “services are developed in large communities linked through platforms and networks of businesses,” and “without such platforms and networks, these innovations would not become as successful or even exist” (p. 495). In addition, Kowalkowski et al. (2013) present two roles of a platform in organizing inter-firm value constellations in the servitization context of small- and middle-sized enterprises (SMEs). The first is an operative platform – a “shared service platform” (p. 25) – that enables third parties (supply chain members) to provide services in addition to the offering of the focal firm. The second approach resembles an online marketplace in which the focal company has a “customer-to-customer intermediary” role (p. 23), facilitating the independent transactions between the demand and supply side.

The possibilities of service platforms have also been studied in the wider perspectives. Gebauer et al. (2013) characterize different types of service networks and show how different service settings are addressed by different service network configurations. In these cases, the platforms are represented as bases of actors who could be mobilized to form a solution. Spring and Araujo’s (2013) suggest that the manufacturer’s factory should be perceived as a set of productive opportunities, a repository of knowledge – and a platform for services. Correspondingly, firm networks could be viewed as a network of productive opportunities, not strictly specifying who drives the innovation and delivery of the services. Therefore, the authors propose that companies should focus on developing interfaces for the surrounding service systems.

Although being relatively scattered among different views of the role of platforms, the service-oriented platform literature forms a vivid narrative, starting from the view of platforms as ways to accommodate a firm’s increasing service offering variety without increasing the organizational complexity to using the complexity of the networks for the benefit of the platform orchestrator. Specifically, the mindset has changed from intra-firm service development and service modularization to agile network orchestration and mediation. However, few studies have elaborated in detail how service network-originated complexity is leveraged. Using a multiple case study design, it is our aim to explore how and to what extent firms can leverage network complexity to their benefit with platform approaches.

3. Methodology

3.1. Research design and sampling

We conducted a multiple case study (Yin, 2009) to explicate platform strategies in the context of service operations in manufacturing organizations. The case study method was selected because the research problem and research questions are empirically novel and theoretically vague (Eisenhardt, 1989). The problem in question seemed largely unexplored and original, and therefore case studies allowed us to discover and theorize this phenomenon in great detail (Eisenhardt, 1989). Our study is an explanatory analysis based on multiple case comparisons, aiming toward rich data descriptions and the conceptualization of the phenomenon.

Four distinct cases were selected according to criteria supporting our theoretical suggestion that relational and technical networks are formed in industrial manufacturing and service provision settings in order to leverage network complexity. Theoretical sampling was deployed (Glaser & Strauss, 1967) to find cases that would have strong symptoms of network-type operations and would demonstrate characteristics of platform strategies (the companies themselves refer to the term “platform” when analyzing their operations). Our sample included firms that have consistently followed a path of product level modularization and platform building, and for this reason the language of platforms was familiar, ensuring additional confidence in concept understanding, leading to construct validity. We aimed to examine cases that would use a network approach to connect not only the components of products but also resources and actors in order to form solutions that would be beyond the competence of any single actor (i.e., companies aiming toward elevated service offerings, see Agarwal & Selen, 2009).

3.2. Data collection and analysis

The data were collected using a semi-structured interview protocol (Patton, 1990). We preferred this option because it was our aim to construct a theory, not merely to test theoretical assumptions. The flexibility of the interview protocol provided us an opportunity to include topics and concepts that we otherwise might have missed as well as issues that were not raised in the process of grounding the theory. The interview themes included questions on 1) how the firms define and describe the platform strategies (i.e., what is a “platform” in their case?); 2) why the platform approach seems appropriate for the context; 3) what benefits these firms are trying to gain with platforms, especially from the perspective of managing the internalization/externalization of resources and capabilities; 4) how the firms have practically proceeded and how they are progressing with using the platform approach; and 5) what actors are involved in the platform.

The informants were mainly vice presidents of operations and marketing, marketing managers, and project managers, but in addition our data included personnel from the shop floor level. We wanted our sample to be sufficiently wide and deep to understand the phenomenon and its richness within organizations and on different dimensions, this being in line with the theory suggesting that platform characteristics can be found in several layers of the organization. However, this approach forced us to focus on individual organizations instead of on modeling large networks because the inclusion of multiple players would not have given us detailed data and would have limited our ability to understand the special characteristics of platforms. Thus, the study represents four deep dives instead of a single dip into a multiple stakeholder network.

Forty-two interviews were conducted. Each interview lasted an average of one hour (ranging from forty-five minutes to three hours). All interviews were tape-recorded and transcribed. The contents of the interviews were analyzed using thematic coding (Gibbs, 2008; Miles & Huberman, 1994). In proceeding with the thematic analysis, we followed the steps described by Braun and Clarke (2006). First, we decided on

the breadth of the description. As the platform approach to servitization is relatively under-researched, we decided to keep the description of the dataset rich. Then, driven by our analytic interest in the area, we decided to use a theoretical approach to thematic analysis. This meant that the empirical data were primarily used to elaborate and further develop the theory-originated combination of servitization and platform strategies.

A semantic approach was used for theme identification, steering us toward the explicit and essentialist meanings of the data. Correspondingly, the data were descriptively organized to show patterns of semantic content. The results of this work are reported in the findings section of this article. We then interpreted the broader theoretical meanings and implications of the data and reported them in detail in the discussion section.

3.3. Detailed case descriptions

In the following section, the case companies' background information and motivations behind their platform implementations are described. The general description of the data can be found in Table A.1 in Appendix A.

3.3.1. Case MarineCo: technological platform enabling service delivery and fostering relationships with stakeholders

The case of MarineCo focuses on a remote diagnostics platform used to integrate different technological modules and components and the human actors operating them. MarineCo is a component and systems supplier operating in the marine logistics sector. Complex platform–proprietary technological interfaces, e.g., high-resolution measuring implementation, are performed as the foundation for the platform system; however, MarineCo has also succeeded in building inter-personal relationships around the platform. Both MarineCo's service personnel and members of the customer organization perceive that they are collaboratively learning by using the platform. In the broad picture, MarineCo perceives that customers are slowly integrating platforms in their processes and perhaps even adapting the processes to the platform's design principles. MarineCo considers that this development is enhanced by the platform-provided ability to understand the customer's context-specific details regarding the actual value that the services are providing and that the systems approach creates more service opportunities than the independent components do.

3.3.2. Case RoofCo: integrator bridging customer and supplier networks

RoofCo is a large component producer and service provider of building infrastructure solutions using a platform to gather together diverse actors from the supply network. The platform approach is believed to keep the service provision network agile, innovative, responsive to the individual customer needs, yet controllable by the orchestrator. By leveraging the inter-organizational trust it has in the industry, RoofCo strives to be a social integrator, which it defines as an intermediary for small service providers and customers. RoofCo aims to act in this role to channel the service delivery through a platform, perceiving this to be a way to gain information about use value and customer problems and to reveal potentially opportunistic behavior within the network. Roofs are part of an interconnected building system, and service needs related to roofs often involve other components; therefore, the addition of other building components on the platform is considered. According to RoofCo, digital sensing, measurement, and data on the buildings offer knowledge about service potential that could be leveraged through the platform-based service network.

3.3.3. Case LogisticsCo: knowledge platform to provide top-class customer care

LogisticsCo is a company leveraging its network in order to extend customer care beyond its own products with the assistance of a maintenance platform that combines information about the installed base.

LogisticsCo has the majority of its investments tied up in manufacturing, yet after sales, the maintenance and optimization of the logistics fleet form the core of the business. LogisticsCo has created a platform for maintenance workers in order to discuss on-site solutions and problem solving.

What is unique about this company is that they are not merely reliant on their own mechanics but they also leverage competitors' knowledge on different technology. The actors, including the competitors, use the platform innovatively to combine knowledge-driven resources and together develop the best solution for their customers' needs. Because of the platform, customers are able to access the capabilities of multiple suppliers and thus gain more value. As the service orders are channeled through the platform, information is collected about the installed base and the value-in-use. The actors focus on sharing cumulative knowledge of diverse contextual factors related to collected information. The sharing is enabled by formation of relational capital between the company's own mechanics and third parties (in the form of social connections). This encourages the actors to trade their own proprietary information for valuable new knowledge from the others. The platform offers ways to influence, for example, what data are shared, even in unanticipated settings.

3.3.4. Case MaterialCo: placing material at the core of the ecosystem

MaterialCo produces materials and components for the construction industry aiming to gather together diverse actors from the supply network. The platform approach is applied to solve systemic problems in the construction industry in specific building contexts, including the identification of the underserved actors, their needs in the construction context, and the possible role that construction materials could have in solving the problems. The company has invested heavily in R&D and has launched a new type of construction material that has certain features that make it possible to build innovative structures with contemporary architectural and design characteristics. The platform implementation would enable connections between many different actors, providing opportunities for the creation of unique value offerings. MaterialCo also aims to synchronize the interests of actors and even to morph their roles in favorable directions by providing insights and tools. One of the primary aims of MaterialCo is to break with rigid industry structures and create bridges between different industries.

4. Findings

We present the central findings of our case studies in the following sections. We start by reviewing (in Section 4.1) how the chosen cases reflect a platform approach to leverage the complexity involved in the networked service provision. Then, we present three distinct platform logics according to which service-based exchange is organized (Section 4.2).

4.1. Benefiting from the complexity involved in the networked service provision

The thematic analysis revealed five different ways in which the companies use platforms to leverage the complexity involved in the networked service provision. These are related to 1) extending the network orchestrator's reach in complex supply networks with platform-based attractors, 2) leveraging a complex supply base by gathering innovative resource and capability combinations, 3) using diverse relationships to strengthen relational processes and create social dependencies, 4) learning and recognizing the diverse contextual factors of actors, and 5) restructuring the competition by leveraging the changing actor roles. These findings are summarized in Table 1.

4.1.1. Extending the orchestrator's reach in complex supply networks

According to cases, platforms enable companies to gather together diverse actors – companies, individuals, and even technological machinery

Table 1
Mechanisms of leveraging complexity with platforms (in studied cases).

Mechanism of leveraging complexity	MarineCo case	LogisticsCo case	RoofCo case	MaterialCo case
Extending the orchestrator's reach in complex supply networks	Reaching actors inside customer organization's boundaries	Attracting competitors to join platform for solution provision	Gathering together diverse actors from the supply network	Gathering together diverse actors from the supply network
Leveraging a complex supply base by forming new resource and capability combinations	(no significant empirical evidence)	Increasing visibility of multiple suppliers in the network	Enabling companies to extend their offerings by creating opportunities for collaboration	Flexible ICT architecture and open interfaces facilitate connections between many different actors, leading to unique value offerings (No significant empirical evidence)
Using diverse relationships to strengthen relational processes and create social embeddedness	Embedding service personnel deeply in customer's operational processes	Forming relational capital (in the form of social connections) between service providers in the network	Striving to be a social integrator (connection point for small service providers and customers)	
Recognizing the diverse contextual factors of actors	Acquiring access to the value in the customer organization's social context	Channeling service orders through the platform and gaining information about use value and problems	Channeling service orders through the platform and gaining information about use value and problems	(No significant empirical evidence)
Restructuring the competition by leveraging the changing actor roles	(No significant empirical evidence)	Creating shared vision among actors	Revealing potentially opportunistic behavior among different actors	Synchronizing the interests of actors and even morphing their roles in favorable directions by providing insights and tools

– from the networked supply bases beyond the traditional collaborative networks. This characteristic is exhibited in all cases. In RoofCo, the company aims to attract small service providers in the industry to join the platform to provide an agile and innovative service network. The aim of MaterialCo was to gather together diverse actors extending beyond the traditional construction industry in order to facilitate the formation of new offerings. LogisticsCo took a more aggressive approach enabling the company to attract even competitors to join the platform. MarineCo, in turn, was able to reach actors who were far beyond the organization's boundaries (i.e., actors only involved in internal processes).

In all cases, the platform created an environment (usually in the form of an ICT system) in which the networked operations could take place. A practical and virtual “place to meet” seems to be a key resource in extending the orchestrator's reach to complex supply networks. However, the LogisticsCo and MarineCo cases also show that this process is enhanced by communicating possible shared interests to network members (regarding the development of the industry and potential shared advantages) and helping them reach their own business targets and support mutual goals. In LogisticsCo, the mutual goal was to support the uninterrupted operations of the customer, whereas with MarineCo it was to promote the safety and performance of the vessel.

4.1.2. Leveraging a complex supply base by forming new resource and capability combinations

Our cases revealed how complex customer needs require connectivity among different actors; the visibility enabled by the connectivity often leads to novel resource and capability combinations. The case of the LogisticsCo shows how platforms enable customer access to the capabilities of multiple suppliers, increasing the value of LogisticsCo's offerings. At the same time, LogisticsCo receives essential information on the relationships between the customer and suppliers in order to create cumulative knowledge on relevant maintenance history achieved through the relational processes. The RoofCo case shows how the integration of fragmented networks enables these companies to expand their own offerings, thereby meeting customer needs previously out of their scope. RoofCo aims to leverage its trust and central position in its network and perceives itself as being able to effectively connect its own product customers with local third-party service providers. Instead of a basic partnering solution, the company aims to rely on the platform approach to keep the service provision network agile, innovative, and responsive – and also sufficiently controlled.

MaterialCo facilitates the formation of new complex resource combinations and developing offerings that no company alone could design, develop, or deliver. MaterialCo attempts to create novel and complex

resource configurations in the network with flexible information technology architecture and open interfaces. The orchestrator's role in these new combinations is to connect stakeholders who had not previously had the possibility to connect, to help in navigating through the traditional conventions in the industry and to assist in breaking industry boundaries.

4.1.3. Using diverse relationships to strengthen relational processes and create social embeddedness

The network facilitation characteristics of the case platforms make it possible to leverage diverse social relationships in the industry structures. MarineCo offers a modular customizable environment for implementing common processes and learning possibilities, using remote technology for problem solving on ships. In this way, MarineCo builds social structures that lead customers to rely on its platform whenever problems occur or when other assistance is needed. MarineCo operators are able to embed themselves in the customer's own operational processes, both in terms of rational problem solving and courteous, friendly and responsive person-to-person support. The platform-mediated social space creates opportunities to connect, even for the most critical safety issues.

RoofCo, on the other hand, strives to serve as the trusted connection point for smaller service providers and customers, positioning it as a social integrator. The intention both to connect previously unknown parties and to embed its own product components in the operations aims to secure RoofCo's role in the future service network. LogisticsCo, in turn, relies on third-party mechanics to assist with maintenance operations when the required capabilities extend beyond its limits. LogisticsCo is then able to form relational capital (in the form of social connections) between maintenance workers. The openness enables generating trust not just with the customer but also with the third parties that are LogisticsCo's traditional competitors. This trust enables all members of the network to share proprietary resources through the platform and thus gain more business.

4.1.4. Recognizing the diverse contextual factors of actors

The diversity and complexity of the different usage contexts create challenges for the service exchange. According to the case evidence, platforms offer help in addressing this challenge. The MarineCo's case example illustrates how social embeddedness enabled by the platform approach provides access to the value in the customer organization's social context. Thus, the contextual features of the customer regarding value offerings could be learned and leveraged. In the MarineCo case, as most of the communication related to the service operations is performed via the platform, the parties become aware of the intrinsic experiences hidden behind structured feedback.

RoofCo, in turn, strives to offer its own sales channels to the customer and in this way acquire critical information on service needs that are often direct indications of value in use. This demonstrates how information on contextual factors can be gained even when leaning heavily on the supply network for service delivery. By aiming to channel the service delivery through its system, RoofCo plans to keep customers satisfied and expects to gain important information about use problems. This also enables externalizing the service provision to the network but maintains close contact with the customer regarding the value-in-use knowledge. In a similar way, LogisticsCo is able to gain value-in-use information by channeling customer orders through its system, even if a competitor offers the business case and the repair itself is done by a third party.

4.1.5. Restructuring the competition by leveraging the changing actor roles

According to the cases considered in our study, the platform approach can make it possible to help with uncertainties in the value co-creation expectations between the networked actors, especially by stabilizing the inter-organizational power balance and the roles of actors. A platform approach opens the possibility to act as an intermediary, revealing potentially opportunistic behavior among different actors in the network. In the RoofCo case, identifying and controlling the roles of the companies in company's networks are perceived to be important in terms of creating more opportunities for the actors to cooperate. Correspondingly, in the case of the LogisticsCo, the threats of the unwanted changes in the actors' roles and power dependencies were mostly tackled with the clear communication of the shared vision and support of the aims with platform's functionalities. The actors involved were all concerned about the usability of the machinery, which directly reflected the performance in product business. Operating in the LogisticsCo's platform prevents opportunistic behavior and encourages all actors to support common goals. In addition, as illustrated in the case of MaterialCo, by providing a common vision and complementing it with insights and tools derived from the resources the orchestrator possesses, the platform orchestrator could also aim to synchronize the interests of actors and even morphing the roles in favorable directions.

4.2. Three logics in platforms: connecting, sharing, and integrating

Taking a cross-case perspective to the previously presented case evidence reveals that the platforms differ in terms of how the five complexity leveraging mechanisms are prioritized in the implementation. In addition, the instantiations of mechanisms, i.e., how the mechanism works in practice, varies between platforms. The results converge to three distinct ways of organizing platforms. On the abstract level,

platforms appear to enable functions of 1) connecting actors, 2) sharing resources, and 3) integrating systems. We refer to these as the “logics” of a platform. It seems that leveraging service network complexity is configured differently among these logics. The evidence also suggests that, in our cases, one of these logics is dominant while the others play lesser roles. Below, we describe the characteristic features related to each of these logics, especially with regard to the corresponding mechanisms of leveraging complexity. A summary of this work is presented in Table 2.

The first logic, connecting actors, is about providing opportunities for further collaboration, and even creation of new markets. This logic is prevailing in the platforms of MaterialCo and RoofCo. When operating the platform with connecting logic, a firm uses a complex supply base to form innovative actor constellations, but further collaboration (sharing and integrating) plays a minor role. Each of the participants joining the platform decides the value that they derive from the connectivity. In this process, synchronizing the interests of actors to reveal opportunism and even morphing their roles in favorable directions is a key role. The essential core is to create connectivity, which in itself creates value in the network. Apart from this case study, the logic is well illustrated, for example, by the LinkedIn platform, connecting different professionals and serving as a “virtual business card directory”.

The second identified logic is based on resource sharing. In this logic, the operations in the platform are based on the mutual understanding that sharing proprietary resources can benefit the individual actors in service innovation and provision. The role of the platform implementation appears to be 1) facilitating relationship development between actors to gain trust and 2) giving the firms a required level of influence and protection regarding what is shared while leaving the actors enough freedom to organize their actions as they desire. The latter characteristic seems to help especially in addressing unanticipated customer needs. A key factor in leveraging “sharing resources” logic is addressing the threats of unwanted changes in the actors' roles. In the case platforms, this is done by clear communication of the platform's vision. Although resources and capabilities are shared among actors to some extent in all case platforms, the LogisticsCo platform is the only case in which the sharing logic prevails in our study. From other domains, an illustrative example of this logic is the AirBnB platform. By facilitating resource sharing between travelers and house owners, the platform creates unique traveling experiences and facilitates better resource use.

The third logic conceptualized from the cases is “integrating systems”, that is, forming an efficient service delivery system. This is the most traditional approach for manufacturers that rely on their supply network to deliver value. The integrating systems logic seems to include characteristic features of interfacing and connecting different assets, whether they are technological machinery, human actors, or the resource-capability

Table 2
Logics in platforms and corresponding mechanisms of leveraging complexity.

Mechanism of leveraging complexity	Connecting actors logic	Sharing resources logic	Integrating systems logic
Extending the orchestrator's reach in complex supply networks	Gathering together diverse actors from the industry, supply network and inside the organizations	Attracting parties that perceive themselves as adversaries to join the platform	Reaching actors who are inside collaborating organizations' boundaries
Leveraging a complex supply base by forming new resource and capability combinations	Platform structure and interfaces enable connections between many different actors, providing opportunities for new value offerings	Encouraging actors to provide access to each other's proprietary resources to pass on greater value to the customer	(No significant empirical evidence)
Using diverse relationships to strengthen relational processes and create social embeddedness	Striving to be a social integrator (connection point for different actors)	Forming deeper social connections between actors and building trust between them	Embedding actors of collaborating organizations deeply in each other's operational processes
Recognizing the diverse contextual factors of actors	(No significant empirical evidence)	(No significant empirical evidence)	Channeling the service delivery and feedback processes through the platform and gaining information about use value and problems
Restructuring the competition by leveraging the changing actor roles	Synchronizing the interests of actors to reveal opportunism and even morphing their roles in favorable directions	The dangers of the unwanted changes in the actors' roles tackled with clear communication of the platform's vision	(No significant empirical evidence)
Prevailing logic in studied cases	MaterialCo and RoofCo	LogisticsCo	MarineCo
Prevailing logic in other contexts	LinkedIn	AirBnB	Salesforce.com

connections. In these terms, the logic overlaps with connecting actors' logic, but the desired outcome is different. While connecting logic connects parties in order to create opportunities for new offerings, integration logic stresses operational efficiency via embedding actors in each other's processes. Compared with the sharing resources logic, integration aims toward control of value creation – in contrast to sharing, in which value creation happens among the actors in the system, without gatekeeping. An illustrative example of integrating systems logic outside manufacturing context is e.g., Salesforce.com. The platform has its own extensive offering that is complemented by the third-party developer community. The company maintains a dominant position in the network, setting the guidelines and rules according to which the partners may operate.

5. Discussion

Our study reports on ways in which service-driven manufacturers aim to use platform approaches to leverage the complexity inherent in solution networks. The most important means seem to be the discovery and analysis of resources and capabilities available in the inter-firm networks and use of technological systems to make the resources and capabilities visible for the network members to leverage. By offering a way of orchestrating the inter-firm network, especially with regard to managing firm boundaries and interfaces between firms, a platform approach can assist companies in turning complexly interlinked actors and their resources and capabilities into assets. These efforts make it possible for actors to offer more comprehensive solutions, which then leads to improved customer orientation.

We identified five ways in which service-driven manufacturers leverage network complexity to their benefit and found that prioritization between these five mechanisms varies between platforms. Our findings also revealed that these prioritizations could be categorized into three distinct “logics”: connecting actors, sharing resources, and integrating systems. Our cases demonstrate that one of these logics dominates and the others play a lesser role.

This research contributes both to the service and platform literature. In the service research domain, the results advance the platform-related servitization discussion, further expanding the focus and moving away from simply reducing complexity (Pekkarinen & Ulkuniemi, 2008) to leveraging complexity in the service business in highly innovative ways (Den Hertog et al., 2010; Gebauer et al., 2013; Kowalkowski et al., 2013; Palo & Tähtinen, 2011; Spring & Araujo, 2013). Our study extends and brings greater detail and structure to this discourse. The results demonstrate in practice how firms aim to take advantage of the complexity inherent in service and solution networks. The five different categories and three distinct logics offer the possibility of finding commonalities and sources for generalizations lacking in current research (e.g., Gebauer et al., 2013; Kowalkowski et al., 2013; Spring & Araujo, 2013).

Our findings also suggest that because customizability requirements of the offerings and the complexity of the service network structures are increasing, the goal of managing and reducing complexity might be reaching its limits. Our case companies seem to prefer to openly seek diverse opportunities and maintain only enough structure to prevent opportunism in inter-organizational relationships. We anticipate that this is a major shift in the servitization discussion, which has in its current approaches focused on controlled and phased shifts (Baines et al., 2009), modularization (Pekkarinen & Ulkuniemi, 2008), and focal-firm and control-oriented modes of operation even in networked configurations (Davies et al., 2007; Windahl & Lakemond, 2006).

Furthermore, this study also contributes to the service partnering discussion. Previous research concludes that complex customer needs require agility and flexibility that may, in some cases, be impossible to deliver through the formal partnering methods influenced by rigid contracts (Agarwal & Selen, 2009; Kowalkowski et al., 2012). Our findings are consistent with these results but offer an alternative approach, which is the use of the platform approach to increase the agility and flexibility in partner formation in a dynamic service business environment. In

particular, the logic of “connecting actors” and “sharing resources” enables actors to collaborate without formal and binding partnering contracts. In these logics, agreements play a lesser role than do the actors' voluntary desires to share resources and cooperate with each other. Based on our empirical data, the firms taking part in the platform may not even know beforehand for which purposes they will use each other's resources. This helps in addressing rapidly changing customer needs and also facilitates the development of new offerings, bringing benefits to all parties. However, this also makes it complicated to define boundaries of sharing and to prevent opportunistic behavior. This phenomenon could alter the inter-organizational structures if platform approaches become more popular: fostering mutual trust among parties sharing resources may play a greater role in the future.

With regard to the theoretical discussion on platforms, the extant typologies do not necessarily reach the level of explanation attained by our results. The platform discourse recognizes platforms that have marketplace characteristics and operate between industries (two/multisided market platforms, see e.g., Eisenmann et al., 2006; Evans, 2003); yet much of this discussion has focused on the economic perspective (e.g., pricing, see Gawer, 2009) without explicating the abstract value that the interconnectedness creates for the markets. Our study contributes to this discussion by extending and abstracting the platform typology by demonstrating the underlying reasons why these multisided platforms exist and their role in shaping the markets.

Thus, our results form a bridge between the somewhat distinct streams of platform discussion, the one originating from product innovation management and the other from economics. The logics of connecting actors, sharing resources, and integrating systems all create value in exchange across the industries. In the connecting logic, value is created to simply connect the actors together, whereas in integration, the central organization takes the lead and control over the operations in order to package and deliver value for the customer. When a platform is constructed on the logic of sharing, the responsibility is divided. Although these logics are very different, they essentially contribute to the same outcome of value creation across organizations and industries.

6. Conclusion

Service-driven manufacturing firms often rely on networks in service operations; however, in order to leverage the network approach, firms must address the challenges of managing and orchestrating the complex inter-organizational relationships. In this study, we were able to identify and summarize how companies aim to leverage network-related complexity in their operations instead of trying to reduce complexity. We showed how platform approaches have been used and could be used in this setting to assist in the flexible externalizing of resources and capabilities, and to provide structure for network orchestration. Although limited to the case study setting, this study provides a rationale for the use of platform approaches in service-driven manufacturing context, demonstrating how all of the identified logics have a special role in value creation in service networks. The importance of the platform approaches might rapidly increase in the future, particularly in the manufacturing context, if digitalization and information intensity continue to progress as they have done over recent decades.

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Appendix A

Table A.1
Cases and data.

Company	Offering and industry	Platform role	Informants' roles in the companies	Total number of informants
MaterialCo (Sweden & Finland)	Materials and components for the construction industry	Enabling cooperation between networked actors by solving systemic problems with a new construction material	<ul style="list-style-type: none"> • Business unit director: 6 • Application manager: 2 • Senior vice president: 1 • Vice president: 1 • Construction manager: 1 • Development manager: 1 • Product group manager: 1 	13
Over 15,000 employees in tens of countries (group level)				
RoofCo (Finland)	Component producer and service provider of building infrastructure solutions	Leveraging focal actors' trust to bridge customer and supplier networks and facilitate new offering creation by third parties	<ul style="list-style-type: none"> • Business unit director: 2 • Research and development manager: 1 • Marketing and sales manager: 3 • Project manager: 1 • Product/service specialist: 2 	9
Over 15,000 employees in tens of countries (group level)				
LogisticsCo (Denmark, Finland)	Intelligent materials handling solutions and services for the logistics industry	Sharing knowledge resources between competitors to enable top-class customer care	<ul style="list-style-type: none"> • Country manager: 1 • Field service personnel: 9 • Field service manager: 1 • Marketing and sales: 2 • Development manager: 1 	14
Around 50,000 employees in 30 countries (group level)				
MarineCo (Finland)	Component and systems supplier operating in the marine logistics sector	Enabling service delivery for physical machinery and fostering relationship formation between stakeholders	<ul style="list-style-type: none"> • Vice president: 2 • Business unit director: 3 • Sales director: 1 	6
Over 100,000 employees in over 100 countries (group level)				

Total number of interviews: 42.

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