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Narrative network as a method to understand the evolution of smart solutions

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1. Introduction

In this era of the Internet of Things, the social and material are more interconnected than ever before. We combine various digital tools and functions in our everyday lives without paying attention; when running, we check our GPS-linked watch to see how much we still need to run. The same watch tells us when to go to sleep, answers our phone, sends and receives emails, and tells us how our night was, and what the weather will be like today. These opportunities that the Internet of Things has to offer are changing our personal lives, the lives of organizations, and the processes of organizing (Andal-Ancion et al. 2003), as well as the lives of traditional manufacturing companies. Previously, manufacturing companies succeeded with quite simplistic, 'produce a lot, and sell a lot' business models, but the transformation towards digitalization has driven the firms to change their business model from pure product manufacturing towards smart solutions (product-service-software system), a transition often coined as servitization (Rabetino, Kohtamäki, & Gebauer, 2017), or later on, with an emphasis on digital, digital servitization (Coreynen, Matthyssens, & Van Bockhaven, 2017; Marko Kohtamäki, Parida, Oghazi, Gebauer, & Baines, 2019). Both servitization and digital servitization, as change processes, are far from simple (Kohtamäki, Einola, & Rabetino, 2020). Tangible products that meet intangible services – products, services, and software – are bundled together into smart solutions to create value for the customer and the manufacturer. Thus, servitization meets the digital, and the manufacturer goes through a transition, where the digital and servitization are developed at least partially in parallel. Multiple studies have suggested this. However, the previous digital servitization literature is relatively silent on this interplay and how it could be framed. The present study intends to use a narrative network as a method to understand the interplay between digitalization and servitization.

The narrative approach has been argued to have a key role in the social sciences for decades (Bakhtin, 1981; Boje, 1995, 2008; Vaara & Tienari, 2011). In this chapter, we use the narrative network as a methodological tool to understand the evolution of smart solutions. As Berger and Luckman already concluded in 1966, when reality is socially constructed, and social can be illustrated as a network of different stories (Abbott, 1992), it seems interesting to study the interconnection of the social and material, for instance the interplay between human activities (sayings and doings)(Schatzki, 2012), and the digital tools. Indeed, Pentland and Feldman (2007: 781) suggest that this interconnection *“can be conceptualized and empirically summarized as patterns of narrative fragments connected into networks”*. We draw from their idea of narrative network, in which the term narrative is used *“to emphasize a set of actions or events that embodies coherence or unity of purpose”* and the term network *“to emphasize that these actions can be interconnected in many different ways”* (Pentland & Feldman, 2007, p.781). To summarize, the narrative network includes two ingredients, network nodes representing *“things that happen”* and network edges representing their consecutive relationship (Pentland, Recker, & Wyner, 2017). That is to say, that in organizational life, or social life more generally, there is not only one “correct” narrative to describe what is going on in our lives or how to define organizational happenings (Weick, Sutcliffe, & Obstfeld, 2005), but also many optional narratives, or pieces of stories. Those pieces of stories, narratives, build the narrative fragments we aim to study in this article. Although narratives can be considered more broadly than in this article, for this article, we narrow the meaning of narrative as series of events or discursive actions *“to make up the core story”* (Pentland & Feldman, 2007, p. 782), which facilitates organizational sensemaking (Einola, Kohtamäki, Parida, & Wincent, 2017) and sensegiving.

This conceptual book chapter intends to extend the discussion about the interplay between digitalization and servitization by introducing a narrative network as a method to understand the interplay and therefore the evolution of smart solutions. As such, the narrative network provides a micro-level lens to study the co-evolution of digital servitization.

2. Theory development

The narrative network approach draws from various theories, such as organizational routines (Feldman, 2000; Feldman & Pentland, 2003; Goh & Pentland, 2019), structuration theory (Giddens,

1984), and actor-network theory (Latour, 2005). A narrative network comprises two core elements as narratives in general: happenings and their sequential relationship (Pentland & Feldman, 2007). Those happenings, pieces of stories, are seen as network nodes, which can have several features, such as who, when, why etc. (Pentland et al., 2017). At the center of building a narrative network is the question “*what happens next*” (Pentland & Feldman, 2007: 788) to emphasize the sequential essence of the narrative network. Furthermore, the narrative network outlines the set of pathways at each point, so the question of “what happens next” becomes a question about network structure, or as Goh and Pentland (2019: 1920) sophisticatedly express it, “*The narrative network framework provides a starting point for operationalizing the conditions for morphogenesis*”. Finally, in all pieces of stories, the sequence labels the development of actions (Pentland, Mahringer, Dittrich, Feldman, & Wolf, 2020).

Using the concept of narrative network theory, we aim to understand the evolution of smart services by modeling the paths manufacturing companies have taken on their way towards outcome-based services and smart solutions.

2.1 Narratives of servitization

As a transition from products to product-service systems, servitization involves strategic and structural components, e.g., strategy-structure fit (Forkmann, Henneberg, Witell, & Kindström, 2017; Kohtamäki, Henneberg, Martinez, Kimita, & Gebauer, 2019). Hence, servitization requires strategic decisions and actions and the development of structures and capabilities to support this major transition. We consider this transition through ten sequential narratives or core stories.

Since the beginning of the Second Industrial Revolution in 1870, manufacturing companies have used more or less the same business logic: cost reduction and profit maximization through mass production, large-scale manufacturing with standardized products (Ramírez, 1999). These traditional **(A) manufacturing products** with add-on services is also the starting point of our analysis (Oliva & Kallenberg, 2003). After a centuries-old manufacturing tradition, companies started to see new business opportunities in adding some simple services and systems to their manufactured products (Matthyssens & Vandenbempt, 2008). In the value systems of industrial manufacturing companies, we have also witnessed movement regarding make-or-buy-decisions, integration and

disintegration (Hobday, Davies, & Prencipe, 2005). One way to see the structure of the architecture of an industrial value system has been from raw material suppliers, to components suppliers, systems suppliers, solution integrators, operators, and customers (Davies, 2004; Rabetino & Kohtamäki, 2018). While value systems are not all the same or equal, and value system architectures involve much variety, the transition from a system supplier position towards the downstream has been seen as a means to increase competitive advantage (Brady, Davies, & Gann, 2005). **(B) Supplying simple systems** has been a strategic position for many manufacturers looking to move towards the downstream (Rabetino & Kohtamäki, 2018). Thus, when traditional manufacturers' perception about customers was that they "*destroy the value*" (Ramírez, 1999: 61), we later observed the emerging customer emphasis in the literature concerning manufacturing firms (Wise & Baumgartner, 1999). To some extent, manufacturing firms woke up to **emphasize customer needs** (Kindström, 2010; Rabetino et al., 2017) to co-produce value together with customers (Vargo & Lusch, 2004).

Although starting to understand the role of customer needs and add-on services, many companies maintained their **(D) cost-based pricing** practices when selling products, add-on services, and simple systems. Cost-based pricing supports effective but sub-optimizing exchange behaviors with the an emphasis on low costs and short-term profits, resulting to low seller differentiation and power (Ulaga & Eggert, 2006). To differentiate, servitizing companies started **(E) integrating products and services into solutions** to become customized integrated solution providers (Kohtamäki et al., 2019). The provision of integrated solutions intended to decrease the buyer's transaction costs by integrating more complex offerings into systems, bringing customers closer to the servitizing manufacturers (Bigdeli, Bustinza, Vendrell-Herrero, & Baines, 2018; Huikkola, Rabetino, Kohtamäki, & Gebauer, 2020), the manufacturers moving downstream (Wise & Baumgartner, 1999). Furthermore, delivering complex integrated solutions required a more in-depth **(F) understanding of the role of value** co-creation (Rabetino et al., 2017). Value co-creation is often divided into two separate although intertwined, interaction processes, co-creation and co-production, in which value co-creation is an outcome of the consumption process, and co-production is the interaction in developing the value proposition and creating the core offering (Kohtamäki & Rajala, 2016; Lusch & Vargo, 2006).

To be able to co-create value, companies **(G) started to manage customer relationships** more in-depth. Despite the evident need for good customer relationship management, many companies struggled significantly with execution (Grönroos & Helle, 2010; Richards & Jones, 2008; Vargo & Lusch, 2004). Furthermore, while getting to know customers and building trust through value co-creation, servitizing companies found business potential from **(H) building life-cycle solutions** (Rabetino, Kohtamäki, Lehtonen, & Kostama, 2015). Life-cycle solutions include “the services that support the pre-sales phase (services that contribute to design and construction), the sales phase (services that augment the product offering and basic services for the installed base), and the after-sales phase (advanced services for the installed base)” (Rabetino et al., 2015: 56). This shift towards life-cycle solutions dramatically changed the logic behind the business. As services and solutions started to bring revenues to the servitizing companies, the logic behind offering and pricing changed. Where earlier companies used cost-based pricing (and some of them competition-based pricing), the most advanced companies **(I) started to change towards value-based offering and pricing** (also coined customer value-based pricing) to answer the main question behind this logic: “How can we create additional customer value and increase customer willingness to pay, despite the competition?” (Hinterhuber, Andreas; Liozu, 2018).

In this study, the final phase of the evolution of servitization is coined **(J) offering outcome-based services**, which also prior literature has recognized and acknowledged to be the most progressed model of the servitization process (Baines et al., 2017; Korkeamäki & Kohtamäki, 2020; Visnjic, Jovanovic, Neely, & Engwall, 2017). The basic idea of outcome-based services is that the business logic is flipped from selling products and services to selling and guaranteeing outcomes (Sjodin, Parida, Jovanovic, & Visnjic, 2020). Figure 1 illustrates the narrative fragments and interconnection between the ten phases of servitization.

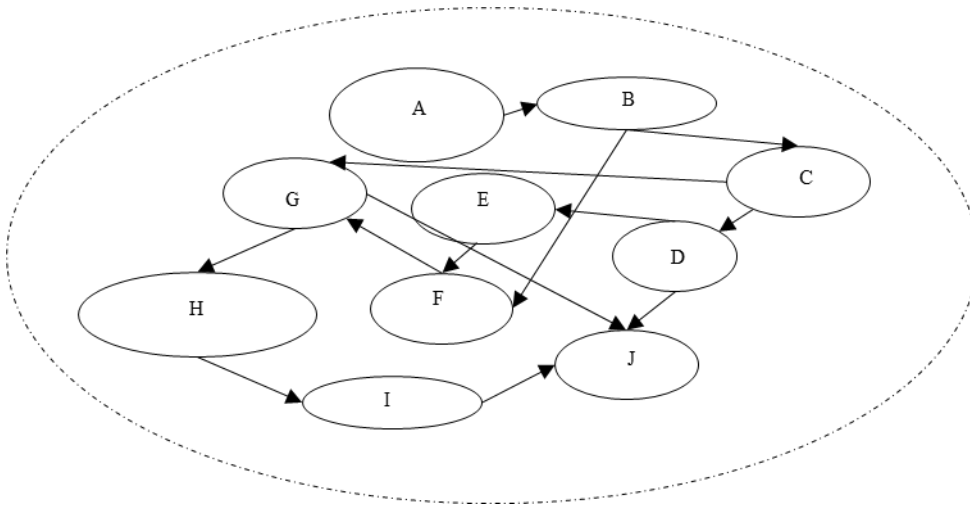


Figure 1. Narrative fragments of servitization with their interconnectedness.

2.2 Narratives of digitalization

Digitalization has been defined as the “*use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business*” (Gartner Glossary, 2020). This chapter defines digitalization as the transition process from sensor development through remote monitoring and optimization all the way to autonomous systems (Porter & Heppelmann, 2015).

The digital transformation started to change manufacturers’ business logic irrevocably in the early 2000s. The first steps towards digitalization were taken, when companies started **(1) sensor development** to add simple sensors to their products to collect data about the usage of the products (Rymaszewska, Helo, & Gunasekaran, 2017). As sensors started to provide data on the products, companies developed monitoring and **(2) remote diagnostics** and found new business opportunities by diagnosing problems remotely and moving from “*‘just in case’ to ‘just in time’*” maintenance (Brax & Jonsson, 2009: 545). With the help of sensors collecting real-time data and developed remote diagnostics, companies started to put effort into anticipating the possible failures of the equipment and initiate maintenance in response to equipment conditions found by various sensors before breakdowns or problems (Grubic & Peppard, 2016; Swanson, 2001), coined here as **(3) predictive maintenance**.

Furthermore, remote real-time monitoring enabled companies to launch **(4) remote control** for the installed base in which some of the problems or errors in the usage of the equipment could actually be noticed and even repaired from a distance. For this purpose, companies built separate control rooms using remote diagnostics to enable, e.g., reliability programs (Grubic & Peppard, 2016). Since the amount of data companies gather and analyze has exploded in the last two decades, the most important task is handling those data to prevent information overload and enable new business opportunities (Opresnik & Taisch, 2015). For these purposes, **(5) big data analytics** offers speed and efficiency for the utilization of the gathered data. Big data analytics aims to improve the performance of the equipment. Overall, the interconnection between various equipment and systems enables **(6) optimization through data analytics** to expand and deepen their offerings towards optimization and outcome-based services (Kohtamäki et al., 2019; Porter & Heppelmann, 2015).

(7) Artificial intelligence is one of the major next steps in the evolution of digitalization. It will transform the services (Rymaszewska et al., 2017) and the business model of servitizing companies and reshape competition (Porter & Heppelmann, 2015). The solutions artificial intelligence can offer for servitizing companies are still in their infancy. However, we have already seen such features as machine learning supporting preventive decisions (Paschou, Rapaccini, Adrodegari, & Saccani, 2020) and digital customer services such as fleet management by AI-enabled optimizations (Sjödén, Parida, Kohtamäki, & Wincent, 2020). As the digitalization process of manufacturing companies proceeds, some of the manufacturers become more like software companies (Immelt, 2017; Töytäri et al., 2018) in processes where software becomes a more relevant part of the manufacturing firm's offerings, sometimes progressing to a stage where the company may begin offering also **(8) software as service**. Furthermore, companies may also progress towards a platform provider business model connecting multiple providers and customers through software (Kohtamäki et al., 2019). Again the question regarding firm boundaries and make-or-buy-decision, are highly relevant in these settings (Kohtamäki et al., 2019)

Finally, fully autonomous systems narrate the final phase of the evolution of digitalization. Although we have witnessed rapid transition towards autonomous ships, cars, etc., it seems that the transition towards this level is still at the very beginning, for *“equipment operating in this category is capable of completing pre-assigned missions, handling deviations, and learning from its operational environment”*(Thomson, 2021). However, in different industries, this development

towards (9) *autonomous systems* is still in its infancy. Figure 2 synthesizes the narrative fragments and interconnection between the nine phases of digitalization.

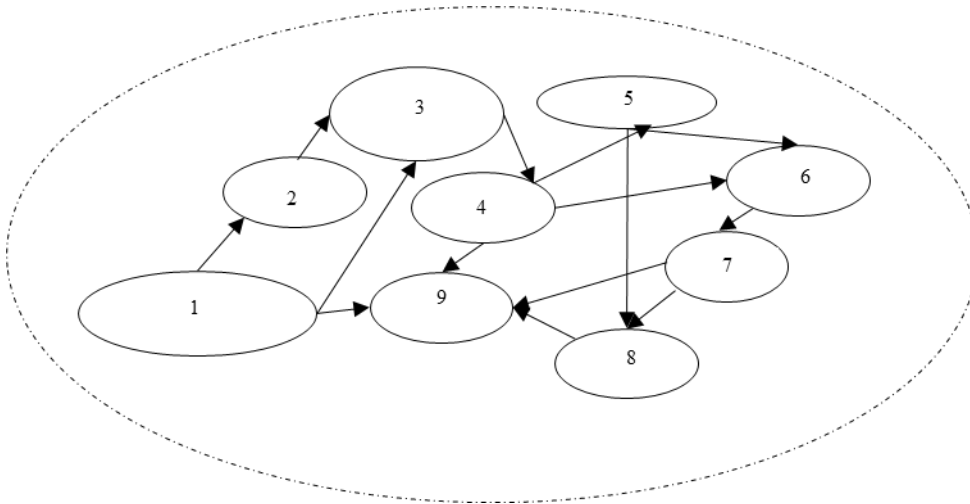


Figure 2. Narrative fragments of digitalization with their interconnectedness.

2.3 Narrative network of digital servitization

Scholars started using digital servitization as a concept to merge digitalization and servitization. Digital servitization is often defined “...as the transition toward smart product-service-software systems that enable value creation and capture through monitoring, control, optimization, and autonomous function. To gain value from digital servitization, firms must capitalize on three dimensions of digital offerings (i.e., products, services, and software), which should work together” (Kohtamäki et al., 2019: 383). Studies have revealed the interplay between digitalization and servitization, and have already provided some preliminary evidence on the financial feasibility of the digital servitization business model (Kohtamäki et al. 2020). Hence, we draw on previous literature to describe manufacturers’ evolution towards digital servitization and smart solutions by constructing a narrative network between servitization and digitalization.

Narrative fragments on the right and left sides of Figure 3 are structured sequentially to form narratives (Czarniawska, 1997). The left side narrates the evolution of servitization and the right side narrates the evolution of digitalization. The middle column illustrates the chronological and

coherent interconnectedness between servitization and digitalization. By doing so, the figure builds a narrative network of digital servitization. Round arrows elucidate the connection among various narrative fragments over a consecutive chronological order inside both phenomena, where straight arrows show the interconnectedness between studied phenomena.

The narrative network of digital servitization builds a story of the co-evolution of digitalization and servitization, with an emphasis on their interplay. Thus, it demonstrates how digital technologies enable the creation and development of new types of smart solutions. In the early stage of servitization, products (A) provided the opportunity to develop sensors and remote diagnostics. When companies started to supply systems (B), remote diagnostics (2) facilitated the emergence of a new business model, and already back then, enabled companies to take first steps towards value-based offering and pricing (I) through predictive maintenance services (3). In addition, remote diagnostics (2) fostered both the understanding of the role of value (Töytäri et al., 2018) (4) and customer relationship management (G). When companies started to integrate more complex solutions (E), big data analytics (5) provided possibilities to not only reduce costs (Opresnik & Taisch, 2015) but also to provide value by controlling and optimizing these systems. Remote diagnostics, together with smart algorithms and big data analytics, enable a manufacturer to offer life-cycle solutions (H). However, this requires data and a proper understanding of the customer's processes and needs. Remote diagnostics increase customer data, enabling improved (4) control and (6) optimization (Porter & Heppelmann, 2015), and providing value-based pricing opportunities for outcome-based services (J). In this instance, the software may also be provided as a service (8). Furthermore, with the help of data analytics (5) and artificial intelligence (7), companies can broaden their scope further to expand their offerings to platforms and autonomous systems (9) (Kohtamäki et al., 2019) in the near future.

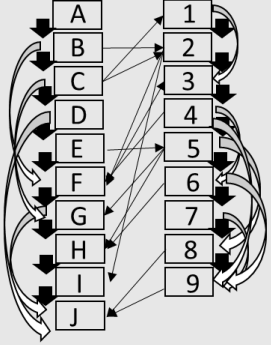
Narrative fragments <i>Evolution of servitization</i> 1	Narrative network of digital servitization	Narrative fragments <i>Evolution of digitalization</i>
A) Manufacturing products B) Supplying systems C) Waking up in customer needs D) Cost-based pricing E) Integrating solutions F) Understanding the role of value G) Starting to manage customer relationship H) Building life-cycle solutions I) Changing towards value-based offering and pricing J) Offering outcome based services		1) Sensor development 2) Remote diagnostics 3) Predictive maintenance 4) Remote control 5) Big data analytics 6) Optimization through data analytics 7) Artificial intelligence 8) Software as service 9) Platform business models 10) Autonomous systems

Figure 3. The narrative network of digital servitization

2.4 Narrative network as a methodological tool

Finding out how to crystallize specific representations or happenings into generalized patterns is essential to understanding organizations (Tsoukas & Chia, 2002; Weick, 1995). Perhaps the narrative network as a method can provide a specific lens to build shared understanding around organizational developmental steps, as the narrative network further organizations “to visualize patterns of action without losing touch with the specific performances that make up these patterns” (Feldman & Pentland, 2003: 791). The narrative network includes two key components as any narrative: 1) happenings (network nodes) and 2) their consecutive relationship in the continuous process of actions (network edges) (Pentland et al., 2017). The narrative network can act as a tool to describe and visualize patterns of actions in and around organizations (Yeow & Faraj, 2011). When building the narrative network, the most critical thing is to answer the question ‘what happens next’ and bear in mind that the relation between narrative fragments should follow chronology and coherence (Pentland et al., 2017). To summarize, the narrative network, as a methodological lens, provides a conceptual tool for “everything that follows” (Pentland et al., 2017: 26).

3. Discussion of the narrative network of the evolution of smart solutions

3.1 Theoretical contribution

Products, technologies, and software artifacts have value only when used by actors (Grubic, 2014). Thus, in the interconnection between the social and material, the actor and the artifact, play a key role when discussing the evolution of smart solutions. In the end, the evolution of smart solutions, from manufacturing products to offering outcome-based services, is far from easy, which is why companies struggle with these solutions (Kohtamäki et al., 2020). To fully understand the complexity of this evolution process, one needs to understand the interconnectedness of all the phases of the process and all the actors inside these processes, the tight intertwining between the material and social, which continues to rewrite the future of smart solutions.

The contribution of this article is twofold. As the first theoretical contribution, we extend the discussion about the complex interplay between digitalization and servitization during their co-evolution. We used the narrative network to uncover the evolution of digital servitization and smart solutions. In doing so, this chapter describes ten narrative fragments of servitization, nine narrative fragments of digitalization, and the dynamic interplay of the fragments, narrative network. First, we frame both servitization and digitalization separately and then build an interconnection between both of these phenomena. This discussion contributes to the digital servitization literature (Kohtamäki et al., 2019; Paschou et al., 2020; Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019), considering its evolution since the turn of the millennium until recently. As the second contribution, this article introduces a narrative network as a method to understand the interplay between servitization and digitalization and, therefore, the evolution of smart solutions. As such, the narrative network provides a microlevel lens to study the co-evolution of digital servitization. The narrative network unravels the interplay between these dimensions coherently and consecutively, where the reader can follow the temporal and spatial narrative uniquely.

3.2 Managerial implications

For managers in digital servitization companies, this book chapter provides some insight into the complexity and interconnectedness of the elements included in the lengthy change process of

digital servitization. Perhaps this chapter gives managers ideas for more in-depth processing of different phases of the change and the possibility to recognize different narratives inside the process. Moreover, perhaps the method can also act as a vehicle when planning the digital servitization process, and communication around it.

3.3 Future research directions

Future studies could collect in-depth ethnographic-type field data about the interconnected processes of digital servitization and build an empirical narrative network to understand the evolution of smart solutions through narrative fragments inside servitizing companies. Furthermore, one could compare digital servitization processes in different organizations or at different organizational levels by using a narrative network as a method. In general, servitization scholars could more often use a cognitive lens (Einola, 2017) and narrative methods to increase understanding about the complex change process that companies face when moving from traditional manufacturing towards digital servitization and smart solutions. As such, we concur with the previous call (Luoto, Brax, & Kohtamäki, 2016) for alternative narratives in servitization research.

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