Towards Explaining Smart Service Innovation Events and Trajectories

Short Paper

Daniel Heinz
Karlsruhe Institute of Technology
Karlsruhe, Germany
daniel.heinz@kit.edu

Christoph F. Breidbach
The University of Queensland
Brisbane, Australia
c.breidbach@business.uq.edu.au

Carina Benz
Karlsruhe Institute of Technology
Karlsruhe, Germany
carina.benz@kit.edu

Gerhard Satzger
Karlsruhe Institute of Technology
Karlsruhe, Germany
gerhard.satzger@kit.edu

Abstract

How and why can smart technologies affect service innovation trajectories? We address this question via a multiple case study approach. First, we identify two dimensions for smart service innovation events: while performing and patterning characterize two distinct mechanisms of smart service innovation, flexible technologies and routines represent constituent elements of smart service systems. Building on these two dimensions, we delineate four ideal types of smart service innovation events and illustrate how these materialize in real-world contexts. Finally, we outline how our findings may serve as a starting point for future research and provide managerial guidelines for those aiming to shape innovation trajectories in smart service systems.

Keywords: Smart service innovation, smart service systems, digital innovation, typology

Introduction

Smart technologies such as big data analytics, cloud computing, telecommunication networks, or sensors enable organizations to offer "smart" services that benefit from enhanced connectivity and contextual awareness (Porter & Heppelmann, 2014). Indeed, smart technologies aim to improve physical products in order to enable new business models (Allmendinger & Lombreglia, 2005; Porter & Heppelmann, 2014) or to increase the interactivity of service processes (Wuenderlich et al., 2015). Applications of smart service range from transportation (e.g., connected cars) to healthcare (e.g., remote surgeries) or also manufacturing (e.g., predictive maintenance or track and trace systems). The IS discipline has approached the phenomenon of smart service in an attempt to integrate organizational and technological aspects via the concept of smart service systems (Beverungen, Breidbach, et al., 2019; Lim & Maglio, 2018). For example, existing works spent considerable effort studying how smart service systems can help to create value (e.g., Knote et al., 2021; Naik et al., 2020) or exploring how organizations can turn into providers of smart services (e.g., Anke et al., 2020; Porter & Heppelmann, 2015). However, despite the important contributions to date, our discipline does not yet provide sufficient insights into how smart technologies enable both service providers and customers to jointly innovate smart services and, thus, reshape (smart) service systems over time (Heinz, Benz, et al., 2022). Therefore, we ask: *how* and *why* can smart technologies affect service innovation trajectories?

We define smart service innovation as *the creation of new, or recombination of existing market offerings through the use of smart technologies* (Lusch & Nambisan, 2015; Yoo et al., 2010). Importantly, while addressing our research question, we differentiate between the changes to actual smart service performance (e.g., what organizations "do") and the potential, yet unrealized, innovation paths accessible to organizations over time (e.g., what organizations "could do") (Pentland et al., 2022). Therefore, the "generativity" of smart service innovation is not a simple feature of technology "as designed" but rather an emergent property of how technology is used in practice. In other words, adding new potential actions is necessary, yet not sufficient, for successful smart service innovation to take place (Heinz, Benz, et al., 2022; Pentland et al., 2022). Thus, we argue that smart service innovation could be better explained – not as a discrete series of deterministic events wherein providers introduce technological features, but rather as an "innovation trajectory" that constitutes a set of changes in the actions that any actor in the service system can potentially perform over time. For example, a machine equipped with sensors can afford its owner various future innovation paths such as detecting inefficiencies, automating logistics, or sharing quality data with customers.

To explain how and why smart technologies can affect service innovation trajectories, we explore this emerging theoretical perspective using a multiple case study that enables us to inductively build theory. We ultimately seek to identify the generative mechanisms that explain how and why specific actions trigger changes in smart service systems – their trajectory – over time (Hedström & Swedberg, 1998). In this research-in-progress article, we establish the foundations for our ongoing research by presenting a conceptualization of smart service innovation and an overall research design, and put forward a typology of smart service innovation events (Doty & Glick, 1994; Krell et al., 2011). Finally, we also discuss the implications of our emerging findings and outline future research steps. As such, our work makes two contributions to service research within the IS discipline: first, our typology represents a theoretical contribution that allows empirical studies to structure observed trajectories of smart service innovation over time and, thus, can help explain how and why the innovation of smart service does (or does not) take place. Second, the novel theoretical lenses on smart service innovation that we put forward emphasize that the trajectory of smart service innovation can be influenced and shaped by a focal firm as well as other actors in a service ecosystem. We begin to explore if, how, and to what extent organizations can "move" between each type over time. Managers may use our typology to recognize potential innovation starting points and pathways, but also outcomes resulting from decisions made, thus allowing for purposefully designing innovation processes with smart technologies.

Conceptualizing Smart Service Innovation

Smart Service Systems. Smart service is "the application of specialized competencies, through deeds, processes, and performances that are enabled by smart products" (Beverungen, Müller, et al., 2019, p. 12). Therefore, smart products, and the technologies enabling them, represent an interface ("line of interaction") between the actors involved within a smart service system. As such, the capabilities provided by smart products can be used to both facilitate the "frontstage" usage (e.g., by increasing the quality or efficiency of a service process) or enable value creation at the "backstage"; for example, by enabling monitoring, diagnosis, or optimization of the service process (Beverungen, Müller, et al., 2019). Importantly, the connectivity of smart products allows multiple actors to simultaneously perceive and actualize such affordances through backstage activities (Heinz, Benz, et al., 2022). However, while boosting the potential for innovation, this also increases the dependencies, complexity, and dynamics in the ecosystem-wide innovation process (Heinz, Park, et al., 2022).

In order to understand how smart service innovation unfolds over time, we adopt Pentland's (2022) notion of "trajectories" to grasp the chronological sequence of these innovative action patterns, emphasizing its emergent nature. A trajectory "entails the evolutionary progression of performances, actualized paths, and the space of possible paths" (Pentland et al., 2022, p. 199). Analyzing the trajectory of smart service innovation can reveal both short-term and long-term consequences of decisions in the innovation process, providing a holistic picture of the multi-actor dynamics that constantly reshape the self-evolving smart service systems (Heinz, Benz, et al., 2022). In what follows, we introduce two concepts that guide our study of smart service innovation trajectories: first, *performing and patterning* as distinct mechanisms of smart service innovation (Danner-Schröder & Geiger, 2016; Pentland et al., 2022), and second, *flexible technologies and routines* as the constituent elements of smart service systems (Leonardi, 2011).

Performing and Patterning as Innovation Mechanisms in Smart Service Systems. Performing and patterning describe actions that shape the configuration of actual vs. potential innovation paths (Danner-Schröder & Geiger, 2016; Pentland et al., 2022). While *performing* refers to the "enactment or actualization of a path," i.e., a specific way of doing a task or getting something done, *patterning* describes the "formation of possible paths," i.e., expanding or contracting the space of possible innovation (Pentland et al., 2022). As such, performing and patterning enable the ongoing emergence of innovation pathways and alter the innovation trajectory. We argue that the trajectory of smart service innovations will either shift towards change that is transformative or "radical" if the number of potentially available paths is increasing ("exploring"), but will conversely remain static or, at best, "incremental" if the number of potentially available paths is shrinking ("exploiting") (March, 1991; Pentland et al., 2022). By focusing on the constructs of performing and patterning, we can therefore distinguish those innovation mechanisms that *translate* potentially available paths into actual smart service performances ("performing") from those that *redefine* the space of potentially available innovation paths ("patterning"). Figure 1 illustrates how these mechanisms are related to smart service systems and smart service innovation.

Flexible Technologies and Routines as Constituent Elements of Smart Service Systems. In his study on the imbrication of human and material agencies, Leonardi (2011) elaborates how the interplay of human actors with their goals and the materiality of a certain technology leads to the construction of perceptual affordances and constraints. Their perception of whether a technology affords or constrains their goals then leads people to change technologies or organizational routines (or have them changed). This is based on the notion of *flexible technologies*, since individual actors can have artifacts modified to align them to their needs (Leonardi, 2011), and *flexible routines* since individual actors typically change their routines (i.e., sequential patterns of social action) to achieve their goals despite the perceived constraints created by material entities. While IT megatrends such as cloud, mobile, robotics, or big data are major drivers of more flexible technologies, today's companies also adopt different work practices that allow more flexible routines in innovation and operation processes (e.g., DevOps, computer-aided design and engineering, process automation, or data-driven decision making) (Legner et al., 2017).

In the context of our study, we argue that smart service is the application of both technologies and routines that are, to some degree, flexible. Further, we propose that smart service innovation typically either results in a change of technology (i.e., features and capabilities of smart products), a change of routines (i.e., repeated patterns of interaction with the smart product to create value), or a sequential alteration of both. Therefore, technologies and routines are recursively the subjects of smart service innovation. Beyond the short-term timeframe, their alteration leads not only to a change in the actual smart service performance but also to a different constellation of possible smart service innovation paths that organizations can choose. Hence, we postulate that the *modification of a smart service system* (i.e., change in technologies vs. change in routines) is a distinct dimension to distinguish events in smart service innovation trajectories. In contrast to purely digital services, smart services are "cybernized," i.e., they blend the physical and virtual worlds (Tuunanen et al., 2019). On the one hand, the physicality of a product often makes subsequent changes difficult. On the other hand, the resulting responsibility of applications such as, for example, autonomous driving systems requires high reliability and robustness. Smart service innovation must, therefore, carefully balance the flexibility and stability of the technologies and processes (Farjoun, 2010).

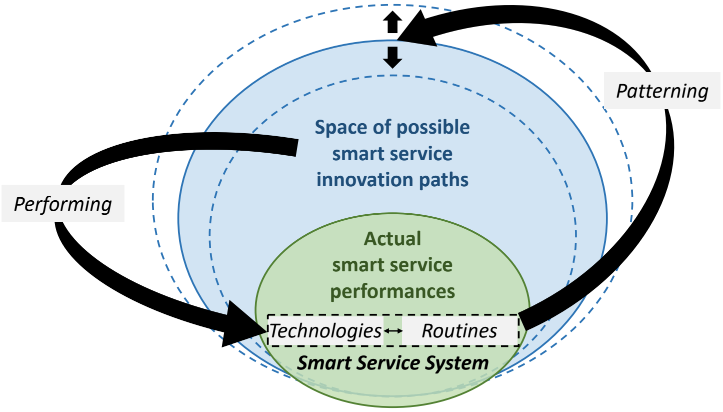

Figure 1. Conceptualization of Smart Service Innovation based on Pentland et al. (2022).

Research Method

Our research objective is to identify causal explanations that answer how and why existing structures in smart service systems trigger smart service innovation, i.e., the creation of new, or recombination of existing market offerings. A critical realism-based multiple case study is an appropriate research design, as it aims to "understand the underlying mechanisms that have generated the phenomena of interest and could do so again." (Bygstad et al., 2016, p. 2). Therefore, our research method was informed by recent studies on critical realism in IS research (Bygstad et al., 2016; Wynn & Williams, 2020) as well as multiple case study research (Miles et al., 2018; Yin, 2018). In our overall research project, we follow a two-stage research design where an exploratory pilot study precedes the main empirical study. This approach is recommended in the literature as it enables us to refine our conceptual understanding of the phenomenon of interest and to identify potentially suitable cases for our main study. We present the results of our pilot study in the following section in the form of a typology, which represents a theoretical artifact that we illustrate with a corresponding use case for each ideal type discussed. A brief overview of our subsequent research process is outlined in the final section.

The *case selection* of our pilot study relied on a criteria-based theoretical sampling approach. Like Ramadani et al. (2022), we developed a protocol to screen potentially suitable cases before data collection. Here, we ensured that the cases are 1) describing a marketable smart service in sufficient detail, 2) providing information on how smart technologies have been an enabler, and 3) showing how the innovation has changed the "legacy" service system. *Data collection* took place from November 2021 to April 2022. It relied on publicly available data sources such as use cases described in success stories of IoT software vendors (51 cases), descriptions by the service provider itself (32 cases), white papers and success stories published by consulting firms (11 cases), and scientific research articles (6 cases). Utilizing multiple sources of evidence was appropriate to combine different perspectives on cases of smart service innovation (Yin, 2018). As a result, we obtained 117 documents and identified 100 suitable use cases to reach theoretical saturation.

The *data analysis* during the pilot study was carried out according to established recommendations and processes (Bygstad et al., 2016; Miles et al., 2018; Yin, 2018). The process was separated into within- and cross-case stages, with our within-case analysis following Yin's (2018) stages of compiling, disassembling, and reassembling. In the compiling stage, we cleaned, verified, and organized the data from different sources using MaxQDA software. Further, we familiarized ourselves with the data by creating summary sheets and highlighting key findings for each use case. The disassembling stage involved the coding of our data using descriptive codes. In this process, we adopt the layered ontology of critical realism (Bygstad et al., 2016; Sayer, 1992) and thus code for structures (networks of social and technical entities), events (observable outcomes produced by these structures), and context (external factors) of the smart service innovation cases. In doing so, we note that some cases involve multiple innovation episodes, so we divide them into sub-units for analysis. Third, we reassemble clusters of descriptive codes into more abstract categories using interpretive and pattern coding (Miles et al., 2018). This enables us to find empirical evidence explaining the interplay between structures and events as a preliminary step towards theorizing mechanisms arising or emerging from these structures and producing smart service innovation outcomes ("events") (Bygstad et al., 2016). Finally, our cross-case analysis followed a variable-oriented strategy (Miles et al., 2018) to identify similar themes and key differences across the cases. We used the presented conceptualization of smart service innovation to structure our narrative in the form of a typology.

Towards a Typology of Smart Service Innovation Events

We now present the results of a typological theorizing approach to delineate four patterns of smart service innovation events along the dimensions of *modification of smart service system* ("*what*?") and *innovation mechanism* ("*how*?"): "problem-solving" (type I), "harvesting" (type II), "modularizing" (type III), and "market-shaping" (type IV). To illustrate the four patterns of the typology, we supplement the description of each type with a corresponding real-world example from our data sample in the form of a case vignette. Figure 2 depicts the typology.

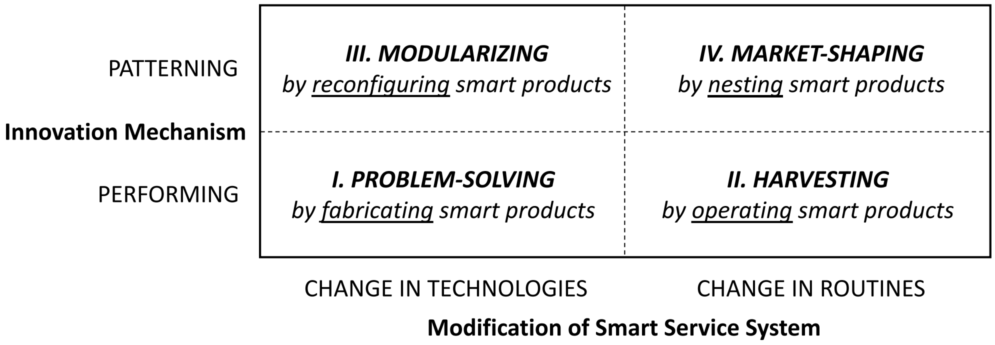

Figure 2. Four Types of Smart Service Innovation Events.

Type I: Problem-Solving

Vignette 1. Illustrating "Problem-Solving" via Trumpf's Sorting Guide (Type I).

German sheet metal manufacturer Trumpf recently transformed its laser-cutting machines into smart products by introducing a "Sorting Guide" to help customers sort sheet metal parts. Prior to introducing this smart product to its customers, workers interacting with the machine often struggled with inefficiencies and a high error rate when sorting the machine's outputs. In response, Trumpf developed a smart product by integrating a camera system, computer vision algorithms, and connecting the machine to the customer's job data management system. Now, when workers manually remove, sort, or pick parts, Trumpf's Sorting Guide provides a smart service by highlighting and grouping individual parts by color-coding (e.g., the same customer order, geometry, or follow-up process) to assist the machine operators (Trumpf, 2022).

Problem-solving is a type of smart service innovation event where a possible innovation path is actualized by actors adopting smart technology to alter the smart service system. Actors within this type may view existing technologies in place as constraining economic objectives or routines (e.g., tedious search for equipment or long waiting times at the physician) (Leonardi, 2011). This smart service innovation event is triggered by actors in the service system perceiving a non-implemented smart technology as capable of changing the materiality of service and deciding to act by turning the potential into actual smart service performance. Hence, innovation aiming to solve existing constraints requires 1) actors to understand a problem, 2) matching the problem with a possible innovation path, i.e., a potential for smart service performance, and 3) actualizing the path by establishing a smart service innovation (Pentland et al., 2022). Therefore, this type of smart service innovation involves *fabricating* smart products so that the product enables problem-solving. Vignette 1 presents an illustrative real-world example this type.

Type II: Harvesting

Vignette 2. Illustrating "Harvesting" via Celli's IntelliDraught System (Type II).

Celli, a leading company in the sector of drink refrigeration and tap drinks, initially implemented smart technologies into their beverage distribution system. The first intention was to enable the multinational beverage and hospitality companies as users of their products to collect data about beverage dispension – thus improving inventory management. However, after the IntelliDraught system was developed and introduced to the market as a smart product (i.e., a Type I smart service innovation event), Celli and their partners realized that collecting data about its equipment and beverage dispension at a point of sale could fuel many other value-adding service offerings; for example, Celli's after-sales department changed their maintenance routines to include remote inspections and program sanitation checks. By turning their established routines into predictive and preventive maintenance processes, Celli could reduce service costs significantly. The customers, on the other hand, actualized these insights by incorporating data-driven decision-making processes in production planning, or improved their marketing efforts via targeted promotions at the point of sale (Microsoft and Celli Group 2020).

This type of smart service innovation event involves actors who change their routines to actualize possible innovation paths. "Harvesting" typically emerges from unintended consequences underlying value-creating routines, identified only after a smart product was implemented and adopted (as per Type I) in a real-world environment. Specifically, while smart products aim to enhance human actors' cognitive capabilities and efficiency using a particular type of technology, operating smart products can involve serendipity effects, thus highlighting unexpected benefits or ideas that reach beyond improving human cognition or efficiency. We, therefore, conceptualize the harvesting type as a form of "effective use" of a smart product (Burton-Jones & Volkoff, 2017), wherein affordances that arise from the relationship between a smart product and a particular actor's goals and context are realized (Strong et al., 2014). Vignette 2 illustrates this type of smart service innovation event using the example of Celli's IntelliDraught system.

Type III: Modularizing

Vignette 3. Illustrating "Modularizing" via Caruso's Telemetric Vehicle Data API (Type III).

Caruso was founded in 2017 as an industry-wide initiative in the transportation sector, to make telemetric vehicle data more accessible to car manufacturers through standardization and new protocols. By introducing a standardized API for such telemetric vehicle data, Caruso rapidly became a market-leader in the domain of connected cars, making smart service offerings (e.g., use-based car insurances or fleet management) efficient and profitable. Caruso also assists third-party providers in discovering other smart service innovation paths that rely on telemetric vehicle data. For example, they provide the technological infrastructure to transfer data from end-users to service providers, or offer sample data sets and technical assistance. Most recently, Caruso launched a data marketplace, thus emerging as an intermediary between data suppliers and data consumers, and offers support services such as processing micro-payments for data suppliers (Gassmann and Ferrandina 2021, pp. 35-54).

Modularizing is a type of smart service innovation event that builds on patterning, i.e., forming novel possible innovation paths. By reconfiguring the technology underlying smart products, organizations intentionally (or unintentionally) expand the configuration of smart service innovation paths, thereby increasing the opportunities for smart service innovation to take place. However, not only expanding but also contracting the configuration of possible paths can enable future smart service innovation events. For example, by modularizing and standardizing the rules of exchange, smart technologies can assume an active (i.e., operant) role in smart service innovation. Thus, specific changes in technology ("reconfiguring smart products") increase a smart product's value as a (potential) smart service "platform," leveraging resource liquefaction and enhancing resource density (Lusch & Nambisan, 2015) – properties commonly associated with digital platforms (Breidbach & Brodie, 2015). The case of Caruso's standardized API for telemetric vehicle data presented in Vignette 3 illustrates this type of smart service innovation event.

Type IV: Market-Shaping

Vignette 4. Illustrating "Market-Shaping" via Relayr's Equipment-as-a-Service (Type IV).

As one of the world's leading reinsurers, Munich Re and their subsidiary company Relayr, enable manufacturing companies to offer their customers "equipment-as-a-service" business models. These pay-per-part offerings provide potential users of smart products with access to technological capabilities without having to buy or lease any equipment. Equipment-as-a-service offerings are enabled by remote and automated monitoring tools that allow a service provider to control, detect, and handle malfunctions. Munich Re and Relayr's offering represents a distinct instance of "market-shaping," since these organizations proactively altered the structure within which manufacturers of technological equipment can share risks and gains with their customers – as well as with Munich Re. Users of technological equipment acting as subcontractors in a given supply chain now can estimate the costs of producing parts in advance and, therefore, adapt their routines. On the other hand, start-ups can benefit from the less capital-intensive cost structure, thus allowing for innovative uses of the equipment (e.g., establishing technical links with upstream or downstream processes) (Relayr 2022).

The fourth ideal type of a smart service innovation event is "market-shaping," which involves organizations or other market participants (Breidbach & Tana, 2021) taking a proactive approach to purposefully change the exogenous characteristics (e.g., the structure or behavior) of the market it operates in (Jaworski et al., 2000; Li et al., 2008; Nenonen et al., 2019). In the context of smart service innovation, we argue that market-shaping involves patterning mechanisms that establish links between previously disconnected stakeholders to enable new service exchanges. We distinguish market-shaping from modularizing (Type III) since market-shaping focuses on changing routines by nesting smart products in a particular application context. In contrast, Type III involves reconfiguring smart products – regardless of context. This distinction allows a more nuanced analysis and explanation of real-world smart service innovation events. For example, as the case of Munich Re in Vignette 4 illustrates, the focal actor shaping a market does not necessarily have to facilitate technological changes by creating or inventing new technologies.

Discussion and Outlook

Our present work aims to explain *how* and *why* smart technologies can affect service innovation trajectories over time. To answer this question, we put forward a typology consisting of four ideal types of smart service innovation events (Doty & Glick, 1994). We illustrated each with a real-world example, thereby contributing novel insights to service research within the IS discipline that advances our understanding of smart service innovation since typologies represent “a unique form of theory building” (Doty & Glick, 1994). We view our work as an important starting point towards middle-range theorizing on smart service innovation, as the identified types are “elementary building blocks” (Merton, 1967) to “white-box” the emergence and dissolution of innovation paths over time. Furthermore, from a managerial perspective, our typology provides insights for decision-makers to recognize potential innovation paths and their outcomes to streamline normative actions and achieve desired outcomes.

Our current results primarily discuss the single building blocks of smart service innovation trajectories by differentiating types of observable events. With our upcoming main study, we intend to expand our findings by analyzing these and other cases in more detail, both in terms of the time span of the case and the considered perspectives by including different informants. In doing so, we aim to strengthen our ability to provide causal explanations for how and why existing structures can trigger smart service innovation. We will investigate events of smart service innovation to theorize long-term dependencies between structures and successful (or unsuccessful) realized innovation paths. The typology proposed in this article can serve as a valuable artifact to reconstruct the cases and code for entities, events, and outcomes related to smart service innovation within each case. By combining case study research (Yin, 2018), grounded theory development (Gioia et al., 2013), and critical realist data analysis (Bygstad et al., 2016) informing our analysis (Antons et al., 2021), we aim to not only trace the innovation trajectories followed in the cases, but also identify patterns in those trajectories, and account for differences in those patterns.

By continuing our research as described, some of the limitations arising from our work’s preliminary stage can be addressed. First, collecting richer data on smart service innovation events (e.g., through semi-structured interviews) can help validate, advance, and illustrate the results presented. Second, the structural and temporal interdependencies between the different types presented can be further elaborated and discussed by linking several closely related events instead of focusing on a single event as an indecomposable unit. We hypothesize that it will sometimes be difficult to separate when routines or technology change (compare, e.g., the dependencies of type I and type II in Vignette 2). Nevertheless, we assume that the presented types can serve as abstract units helping to analyze real complex cases. Third, our research is built on well-established theoretical foundations (in particular: Leonardi, 2011; Pentland et al., 2022). Incorporating an inductive data analysis approach could help surface dynamics that would otherwise be difficult to observe, thus making a greater contribution to the existing body of knowledge. Finally, our preliminary investigation does not discuss in detail whether our proposed typology can be applied to explain innovation trajectories beyond the phenomenon of smart service systems. While we already link to the recent literature on service and digital innovation, we will continually update our literature base as the research project progresses and discuss where our findings can contribute.

Acknowledgements

This work has been partially supported by the German Federal Ministry of Education and Research through the research project “bi.smart” (grant no. 02J19B041, awarded to Karlsruhe Institute of Technology).

References

Allmendinger, G., & Lombreglia, R. (2005). Four strategies for the age of smart services. *Harvard Business Review*, *83*(10), 131.

Anke, J., Ebel, M., Pöppelbuß, J., & Alt, R. (2020). How to tame the Tiger - Exploring the Means, Ends, and Challenges in Smart Service Systems Engineering. *ECIS 2020 Proceedings*.

Antons, D., Breidbach, C. F., Joshi, A. M., & Salge, T. O. (2021). Computational literature reviews: Method, algorithms, and roadmap. *Organizational Research Methods*. https://doi.org/10.1177/1094428121991230

Beverungen, D., Breidbach, C. F., Poeppelbuss, J., & Tuunainen, V. K. (2019). Smart service systems: An interdisciplinary perspective. *Information Systems Journal*, *29*(6, SI), 1201–1206. https://doi.org/10.1111/isj.12275

Beverungen, D., Müller, O., Matzner, M., Mendling, J., & vom Brocke, J. (2019). Conceptualizing smart service systems. *Electronic Markets*, *29*(1), 7–18. https://doi.org/10.1007/s12525-017-0270-5

Breidbach, C. F., & Brodie, R. J. (2015). Nature and Purpose of Engagement Platforms. In R. J. Brodie, L. D. Hollebeek, & J. Conduit (Eds.), *Customer Engagement* (pp. 124–136). Routledge.

Breidbach, C. F., & Tana, S. (2021). Betting on Bitcoin: How social collectives shape cryptocurrency markets. *Journal of Business Research*, *122*, 311–320. https://doi.org/10.1016/j.jbusres.2020.09.017

Burton-Jones, A., & Volkoff, O. (2017). How Can We Develop Contextualized Theories of Effective Use? A Demonstration in the Context of Community-Care Electronic Health Records. *Information Systems Research*, *28*(3), 468–489. https://doi.org/10.1287/isre.2017.0702

Bygstad, B., Munkvold, B. E., & Volkoff, O. (2016). Identifying generative mechanisms through affordances: a framework for critical realist data analysis. *Journal of Information Technology*, *31*(1), 83–96. https://doi.org/10.1057/jit.2015.13

Danner-Schröder, A., & Geiger, D. (2016). Unravelling the motor of patterning work: Toward an understanding of the microlevel dynamics of standardization and flexibility. *Organization Science*, *27*(3), 633–658. https://doi.org/10.1287/orsc.2016.1055

Doty, D. H., & Glick, W. H. (1994). Typologies As a Unique Form Of Theory Building: Toward Improved Understanding and Modeling. *Academy of Management Review*, *19*(2), 230–251. https://doi.org/10.5465/amr.1994.9410210748

Farjoun, M. (2010). Beyond Dualism: Stability and Change As a Duality. *Academy of Management Review*, *35*(2), 202–225. https://doi.org/10.5465/amr.35.2.zok202

Gassmann, O., & Ferrandina, F. (Eds.). (2021). *Connected Business: Create Value in a Networked Economy*. Springer, Cham. https://doi.org/10.1007/978-3-030-76897-3

Gioia, D. A., Corley, K. G., & Hamilton, A. L. (2013). Seeking Qualitative Rigor in Inductive Research: Notes on the Gioia Methodology. *Organizational Research Methods*, *16*(1), 15–31. https://doi.org/10.1177/1094428112452151

Hedström, P., & Swedberg, R. (1998). An introductory essay. *Social Mechanisms: An Analytical Approach to Social Theory*, 1–31.

Heinz, D., Benz, C., Bode, J., Hunke, F., & Satzger, G. (2022). Exploring the Potential of Smart Service Systems: A Multi-Actor View on Affordances and Their Actualization. *Journal of Service Management Research (SMR)*, *6*(2), 132–146. https://doi.org/10.5771/2511-8676-2022-2-132

Heinz, D., Park, H.-R., Benz, C., & Satzger, G. (2022). Innovating Smart Product-Service Systems in Manufacturing SMEs: Current Practices, Affordances, and Constraints. *IEEE CBI 2022 Proceedings*.

Jaworski, B., Kohli, A. K., & Sahay, A. (2000). Market-Driven Versus Driving Markets. *Journal of the Academy of Marketing Science*, *28*(1), 45–54. https://doi.org/10.1177/0092070300281005

Knote, R., Janson, A., Söllner, M., & and Leimeister, J. M. (2021). Value Co-Creation in Smart Services: A Functional Affordances Perspective on Smart Personal Assistants. *Journal of the Association for Information Systems*, *22*(2), 418–458. https://doi.org/10.17705/1jais.00667

Krell, K., Matook, S., & Rohde, F. (2011). Development of an IS change reason–IS change type combinations matrix. *European Journal of Information Systems*, *20*(6), 629–642. https://doi.org/10.1057/ejis.2011.28

Legner, C., Eymann, T., Hess, T., Matt, C., Böhmann, T., Drews, P., Mädche, A., Urbach, N., & Ahlemann, F. (2017). Digitalization: Opportunity and challenge for the business and information systems engineering community. *Business & Information Systems Engineering*, *59*(4), 301–308. https://doi.org/10.1007/s12599-017-0484-2

Leonardi, P. M. (2011). When Flexible Routines Meet Flexible Technologies: Affordance, Constraint, and the Imbrication of Human and Material Agencies. *MIS Quarterly*, *35*(1), 147–167. https://doi.org/10.2307/23043493

Li, C., Lin, C., & Chu, C. (2008). The nature of market orientation and the ambidexterity of innovations. *Management Decision*, *46*(7), 1002–1026. https://doi.org/10.1108/00251740810890186

Lim, C., & Maglio, P. P. (2018). Data-driven understanding of smart service systems through text mining. *Service Science*, *10*(2), 154–180. https://doi.org/10.1287/serv.2018.0208

Lusch, R. F., & Nambisan, S. (2015). Service innovation: A service-dominant logic perspective. *MIS Quarterly*, *39*(1), 155–175. https://doi.org/10.25300/MISQ/2015/39.1.07

March, J. G. (1991). Exploration and Exploitation in Organizational Learning. *Organization Science*, *2*(1), 71–87. https://doi.org/10.1287/orsc.2.1.71

Merton, R. K. (1967). On Sociological Theories of the Middle Range. In *On Theoretical Sociology* (pp. 39–72). The Free Press.

Microsoft, & Celli Group. (2020). *Celli Group transforms the beverage industry with powerful IoT solution*. Microsoft Customers Stories. https://customers.microsoft.com/en-us/story/792978-celli-group-manufacturing-azure-iot (accessed August 22, 2022)

Miles, M. B., Michael Huberman, A., & Saldaña, J. (2018). *Qualitative Data Analysis: A Methods Sourcebook*. SAGE.

Naik, P., Schroeder, A., Kapoor, K. K., Ziaee Bigdeli, A., & Baines, T. (2020). Behind the scenes of digital servitization: Actualising IoT-enabled affordances. *Industrial Marketing Management*, *89*, 232–244. https://doi.org/10.1016/j.indmarman.2020.03.010

Nenonen, S., Storbacka, K., & Windahl, C. (2019). Capabilities for market-shaping: triggering and facilitating increased value creation. *Journal of the Academy of Marketing Science*, *47*(4), 617–639. https://doi.org/10.1007/s11747-019-00643-z

Pentland, B. T., Yoo, Y., Recker, J., & Kim, I. (2022). From Lock-In to Transformation: A Path-Centric Theory of Emerging Technology and Organizing. *Organization Science*, *33*(1), 194–211. https://doi.org/10.1287/orsc.2021.1543

Porter, M. E., & Heppelmann, J. E. (2014). How smart, connected products are transforming competition. *Harvard Business Review*, *92*(11), 64–88.

Porter, M. E., & Heppelmann, J. E. (2015). How smart, connected products are transforming companies. *Harvard Business Review*, *93*(10), 96–114.

Ramadani, L., Breidbach, C. F., & Kurnia, S. (2022). Investigating information and communication technology-enabled national development as a multi-level social process. *Information Systems Journal*. https://doi.org/10.1111/isj.12381

Relayr. (2022). *Equipment as-a-Service. The Future of Manufacturing (Report)*. https://relayr.io/white-papers/ (accessed August 22, 2022)

Sayer, A. (1992). *Method in Social Science: A Realist Approach*. Psychology Press.

Strong, D. M., Volkoff, O., Johnson, S. A., Pelletier, L. R., Tulu, B., Bar-On, I., Trudel, J., & Garber, L. (2014). A Theory of Organization-EHR Affordance Actualization. *Journal of the Association for Information Systems*, *15*(2), 53–85. https://doi.org/10.17705/1jais.00353

Trumpf. (2022). *Sorting Guide*. https://www.trumpf.com/en_INT/products/software/programming-software/sorting-guide/ (accessed August 22, 2022)

Tuunanen, T., Kazan, E., Salo, M., Leskelä, R.-L., & Gupta, S. (2019). From digitalization to cybernization: Delivering value with cybernized services. *Scandinavian Journal of Information Systems*, *31*(2), 83–96.

Wuenderlich, N. V., Heinonen, K., Ostrom, A. L., Patricio, L., Sousa, R., Voss, C., & Lemmink, J. G. A. M. (2015). "Futurizing" smart service: implications for service researchers and managers. *Journal of Services Marketing*, *29*(6/7), 442–447. https://doi.org/10.1108/JSM-01-2015-0040

Wynn, D. E., Jr, & Williams, C. K. (2020). Recent Advances and Opportunities for Improving Critical Realism-Based Case Study Research in IS. *Journal of the Association for Information Systems*, *21*(1), 50–89. https://doi.org/10.17705/1jais.00592

Yin, R. K. (2018). *Case study research and applications*. Sage.

Yoo, Y., Henfridsson, O., & Lyytinen, K. (2010). Research Commentary-The New Organizing Logic of Digital Innovation: An Agenda for Information Systems Research. *Information Systems Research*, *21*(4), 724–735. https://doi.org/10.1287/isre.1100.0322