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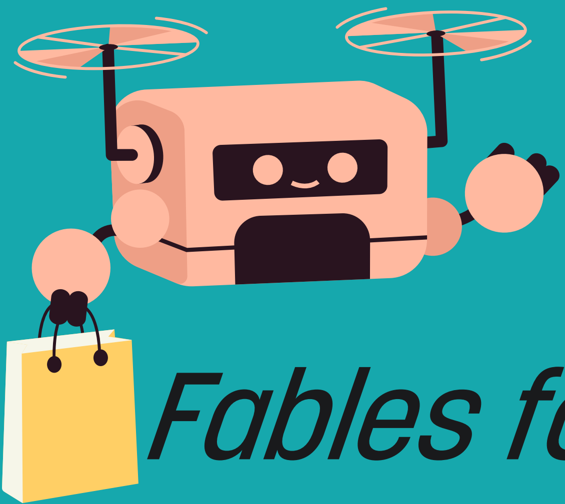

# *Fables for Robots*

# Service Innovativeness and AI

Joanna Pilawa

LINKÖPING UNIVERSITY

# *Fables for Robots*: Service Innovativeness and AI

Joanna Pilawa

Linköping Studies in Arts and Science No. 926
Department of Management and Engineering
Linköpings universitet, SE-581 83 Linköping, Sweden
Linköping 2025

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Linköping Studies in Art and Sciences No. 926

ISBN 978-91-8118-356-6 (print)
ISBN 978-91-8118-357-3 (PDF)
https://doi.org/10.3384/9789181183573
ISSN 0282-9800
Cover image: created using "Canva" free licensed elements
Printed in Sweden by LiU-tryck, Linköping 2025

Distributed by:
Linköping University
Department of Management and Engineering
SE-581 83 Linköping, Sweden

# Abstract

This dissertation explores the concept of service innovativeness (consumer's evaluation of the novelty and meaningfulness of a service) and investigates how artificial intelligence (AI) alters the understanding of service innovativeness and its consequences. Despite its uniqueness in service contexts, service innovativeness is often conflated with service innovation or borrowed from product-based frameworks. In this dissertation, service innovativeness is studied as an interpretation shaped by consumer judgment. Thus, drawing on signaling theory, service innovation is conceptualized as a signal sent by service providers, which consumers decode into service innovativeness. These perceptions then influence consumer responses such as customer satisfaction, adoption, and relative attractiveness.

This dissertation builds on five papers, combining literature review, survey data, and large-scale data scraping. Empirical studies include consumer evaluations from the Swedish Innovation Index, a field study with a service robot, and an analysis of over 12,000 AI-enabled services. The use of diverse research methods allows for a rich understanding of how service innovativeness is formed and how it drives consumer behavior.

Findings suggest that service innovation effectively signals service innovativeness, but the strength of this signal depends on the degree of change. Moreover, we distinguish between product-level and firm-level service innovativeness, which are found to be interrelated. In most cases, the consumer responses to service innovativeness are positive, showing that higher service innovativeness is associated with higher adoption, relative attractiveness, and customer satisfaction. Yet, unlike in other cases, AI-enabled service innovations, while perceived as highly innovative, often lead to lower adoption but higher customer satisfaction.

This dissertation contributes to service research by grounding the conceptual foundations of service innovativeness, applying signaling theory to service innovation, and highlighting the nuanced role of AI. It calls for a more consumer-centric approach to innovation and offers a framework for understanding how service innovations are interpreted and acted upon in increasingly digital service environments.

# Sammanfattning

Denna avhandling studerar begreppet tjänsteinnovationsförmåga (konsumentens bedömning av en tjänsts nyhetsvärde och meningsfullhet) och undersöker hur artificiell intelligens (AI) förändrar kundens uppfattning av tjänsteinnovationsförmåga och dess konsekvenser. Tjänsteinnovationsförmåga förväxlas ofta med tjänsteinnovation eller lånas från produktbaserade förklaringsmodeller, trots dess unika karaktär i en tjänstekontext. I denna avhandling betraktas tjänsteinnovationsförmåga utifrån konsumentens perspektiv. Med stöd av signalteori konceptualiseras tjänsteinnovation som en signal som skickas av tjänsteföretag, vilken konsumenter tolkar till tjänsteinnovationsförmåga. Dessa tolkningar påverkar sedan hur konsumenten agerar och resulterar i ex. kundtillfredsställelse, adoption och relativ attraktionskraft.

Avhandlingen bygger på fem artiklar och kombinerar litteraturöversikt, enkätdata och webbskrapning. De empiriska studierna bygger på kundundersökningar från Svenskt Innovationsindex, en fältstudie med en tjänsterobot samt en analys av över 12 000 AI-baserade tjänster. Användandet av olika metoder möjliggör en djup förståelse för hur tjänsteinnovationsförmåga formas och hur den påverkar konsumentbeteende.

Resultaten visar att tjänsteinnovation effektivt signalerar tjänsteinnovationsförmåga, men också att signalens styrka beror på graden av förändring i tjänsteinnovationen. Vi särskiljer mellan tjänsteinnovationsförmåga på produktnivå och företagsnivå, och dessa begrepp har ett ömsesidigt förhållande i hur de formar konsumentens uppfattning. I de flesta fall är konsumentens respons på tjänsteinnovationsförmåga positiv, vilket visar att högre tjänsteinnovationsförmåga är kopplad till högre adoption, relativ attraktionskraft och kundtillfredsställelse. Dock, leder AI-baserade tjänsteinnovationer, trots att de uppfattas som mycket innovativa, ofta till lägre adoption men högre kundtillfredsställelse.

Denna avhandling bidrar till tjänsteforskning genom att fördjupa den konceptuella grunden för tjänsteinnovationsförmåga, tillämpa signalteori på tjänsteinnovation och belysa AI:s roll. Den uppmanar till ett mer konsumentcentrerat synsätt på innovation och erbjuder ett ramverk för att förstå hur tjänsteinnovationer kan förstås i alltmer digitala tjänstemiljöer.

# Preface

I am aware that the title of this dissertation may appear somewhat misleading, as academic conventions favor clarity and precision in describing one's research already in the title. Thus, I am ready to accept the criticism on that point (as well as any other purposeful or not flaws). Nevertheless, there is a reason behind my choice, and I wish to share it with the reader in this preface.

Artificial Intelligence is not as new a phenomenon as it might seem. Work on it began already in the mid-1950s and 1960s. It is somewhat disappointing that we still do not witness "Star Wars" droids (robots) like R2-D2 (Artoo-Detoo) or C-3PO (See-threepio) walking freely among us, or that the "Hitchhiker's Guide to the Galaxy" Babel fish exists only in the form of Google Translate, with translation often far from perfect. Clearly, technology still has a long way to go before reaching its full potential, and humanity has much to learn in navigate it properly. Yet, we are now witnessing the widespread implementation of AI in the market and can finally imagine science fiction gradually becoming reality.

With this development comes many concerns and debates concerning the ethical aspect of AI, its influence on people, as well as its independence or consciousness. What once belonged to the realm of science fiction has now entered research journals and academic discourse. In this dissertation, I consider AI in services and its effect on consumers. I believe that services provide a gateway for AI to enter everyday life, making it more pervasive and, consequently, more impactful.

The title "Fables for Robots" is not my invention but borrowed from the book by Stanisław Lem. It is one of those works that covered different aspects of AI, robotics, ethics, and the limits of knowledge long before such topics entered scholarly research. While Lem is best known for his novel "Solaris", I find the "Fables for Robots" wittier and more suited for my dissertation, both in spirit and in title. By borrowing this title, I wish to pay tribute to my great compatriot and to remind readers where our reflections on technologies such as AI began. Though I cannot know whether Lem would have appreciated being associated with this work—or agreed with its conclusions— I hope that he would not take offense, and that this humble reference honors rather than diminishes his legacy.

# Acknowledgement

I have started my PhD journey with little understanding of what lay ahead. Reaching this point and writing this part of the dissertation was never an obvious course of action for me. Yet, here I am, and I am extremely grateful to everyone who made it possible and shared this journey with me.

Most of all, I would like to thank those most directly involved in this dissertation and my doctoral studies - my supervisors, Lars Witell and Aku Valtakoski. Having those two as my supervisors, I am afraid I have already exhausted my lifetime's share of luck. I cannot properly convey how much I treasure and appreciate them. Embarking on this journey, I had no idea that I would be gifted with people whom, I dare say, I consider my academic parents (despite their disliking that idea). I am grateful for all their unwavering support, understanding, and patience. I cannot possibly express how important their role has been in my life during those 5 years, not only from a professional but also personal perspective.

Finally, with this dissertation, I am supposed to show my independence as a researcher, and as such, I wish to be considered in the research community. However, I selfishly hope that for those two people, I will always remain their unruly student whom they need to guide and occasionally reprimand.

Thank you!

# Appended papers

1. Valtakoski, A., Pilawa, J., Witell, L.  Of innovativeness, perceived and otherwise: towards a unified framework of innovativeness. *(working paper)*

2. Pilawa, J., Witell, L., Valtakoski, A., & Kristensson, P. (2022). Service innovativeness in retailing: Increasing the relative attractiveness during the COVID-19 pandemic. *Journal of Retailing and Consumer Services*, *67*

3. Pilawa, J., Witell, L., & Kristensson, P. (2025). Service Innovation in the Eyes of Customers: The Swedish Innovation Index. In L. Witell (Ed.), *Service Innovation and Management: Digitalization, Service Infusion and Customer Experience* (pp. 143–155). Cham: Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-76560-5_11 *Published open access under the CC BY license.*

4. Pilawa, J. "So you got the brain but have you got the touch?": The impact of social presence of service robot and service innovativeness on customer satisfaction *(working paper)*

5. Pilawa, J., Rohn, M., Heinonen, K., Quo Vadis AI? Exploring users' responses to and use of AI-enabled services *(working paper)*

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# 1. Introduction

## 1.1 Background

### 1.1.1 Service innovation and its benefits

Service innovations surround us every day. One can pick up a parcel at any time of the day without waiting for a deliveryman by using parcel lockers, which are self-service automated postal boxes that allow for the collection of packages. When using Google Search, one automatically obtains an artificial intelligence (AI) overview, a short textual answer to the searched query based on some of the existing sources. In most big cities, getting from point A to point B has never been easier since electric scooters are available in every street corner and can be rented just by scanning the QR code. These examples illustrate how service innovations enhance convenience and support consumer value creation by offering solutions to everyday challenges. More broadly, service innovation can be conceptualized as the outcome of firms' activities that result in changes to service offerings, delivery processes and resources that bring value to stakeholders (Gustafsson et al., 2020).

Firms increasingly consider service innovation a means to enhance profitability and gain a competitive advantage (Kurtmollaiev & Pedersen, 2022; Randhawa & Scerri, 2015). Empirical research has shown that service innovation is positively associated with market share and sales growth (Lin, 2013). Moreover, C. Feng et al. (2020) and Chen et al. (2009) show that service innovation contributes to both financial and non-financial performance. In conclusion, evidence suggests that investing resources in the development and implementation of service innovations is beneficial for firms, as service innovation plays a pivotal role in driving firms' value (Dotzel et al., 2013).

### 1.1.2 Risk of service innovation failure

Unfortunately, not all service innovations are successful. In fact, most service innovation fails (Witell et al., 2015). Approximately 90% of service innovations fail commercially and disappear from the market within a year (Gourville, 2006). Not only small firms but also big ones risk failing when introducing service innovation. An example is Singapore Airlines' "Flight to Nowhere" service, which planned to offer sightseeing flights during the Covid-19 pandemic (Pratt & Tolkach, 2023). The service never became operational. Service innovations require a lot of resources, so failure can be very costly for a firm. The financial burden of service innovation is often even greater when driven by technology, as technology itself represents a significant monetary cost (Parris et al., 2016).

Still, many firms seek to introduce service innovation by implementing digital technologies, as technology is currently omnipresent. Yet, firms frequently encounter what Gebauer et al. (2020) describe as a “digitalization paradox”: a situation where a firm invests in digital technologies but they do not yield the expected improvements in revenue or performance. Despite heavy investments in service innovations, they sometimes fail to deliver the expected returns, with some estimates suggesting that up to 70% of such projects underperform or fail (Akter et al., 2023; Gebauer et al., 2020; Koetsier, 2020). A striking example of failed service innovations is Google’s Allo, a messaging app that incorporated AI to provide tailored responses to received messages but failed despite its initial promising start in 2016. Only two years after its launch, Google decided to cease further development of the app (Humphries, 2018).

Indeed, service innovations may fail, often weakening the relationship with consumers (Parris et al., 2016) and bringing about not only financial but also reputational losses. Thus, while there are many benefits to implementing service innovations, one should not forget that many such initiatives fail.

### 1.1.3 Importance of the consumer view

With consumers being only one click away from the immense number of services implementing novel technologies, it is not enough to offer just any service innovation. An introduced service innovation needs to stand out from the competition so that it can catch the attention of consumers. Thus, to avoid failure and increase the benefits that service innovations bring, one needs to consider the consumer’s judgment, as it is their attention that firms are fighting for. Eventually, consumers are the final judges of service innovation, and its success depends greatly on them (Kurtmollaiev et al., 2022). For this reason, in the present dissertation, I study service innovations through consumers’ eyes to help providers implement service innovations more successfully. This means that I focus solely on services directly facing consumers, as opposed to those that serve corporate clients.

Arguably, prioritizing the consumer perspective has become increasingly critical in the current landscape, as rapid developments in new service technologies have a significant impact not only on firms but also on consumers and society (Wirtz et al., 2018, 2023). In the service industry, consumers need to familiarize themselves with technological changes faster than ever before (Friedman, 2017). This puts stress on consumers but also potentially leads to frequent shifts in their usage patterns and perceptions of services.

### 1.1.4 Technology in service Innovations

The common enabler of service innovations is technology (Barrett et al., 2015; Gallouj & Weinstein, 1997). Technologies enabling service innovations include automated self-service systems (Barrett et al., 2015; Meuter et al., 2000), the Internet (Featherman & Hajli, 2016), and, more recently, AI and robotics (Huang & Rust, 2021; Wirtz et al., 2023). Technological advancement and increased accessibility continue to create new possibilities for service innovation (Barrett et al., 2015). Thus, service innovations have become even more pivotal, as using the opportunities offered by digital technologies has resulted in a change in how services are provided and consumed (Nambisan et al., 2017).

Traditional technologies were often static and standardized, while AI systems offer dynamic, adaptive capabilities. AI can personalize services, make autonomous decisions, and even engage in emotional or social interactions (Holthöwer & van Doorn, 2022; Huang & Rust, 2021). AI is a computer system that possesses the ability to perform complex tasks requiring human-like mental abilities (Makridis & Mishra, 2022; NASA, 2024; Shankar, 2018). The proliferation of AI, with the automation it allows for, is disrupting service provision and, subsequently, the service industry (Flavián et al., 2021; Robinson et al., 2020). AI greatly influences the service landscape by offering new services, automating previously existing ones, and changing the roles of providers and consumers.

### 1.1.5 Signaling theory as a theoretical lens

Existing research on service innovations provides strong empirical evidence, but it often explains consumer judgments and behaviors primarily through observed findings rather than explicit theoretical reasoning (e.g., Hoang et al., 2025; W.-L. Lee et al., 2022; Zheng et al., 2023). I use signaling theory (Spence, 1973) to analyze and theoretically capture the process by which consumers make judgments of service innovativeness and to link this judgment to their behaviors.

Signaling theory describes the interaction between two actors—sender and receiver (Spence, 1974). Providers' actions and communication efforts, visible to consumers, serve as signals that convey underlying qualities or intention (Connelly et al., 2011). Accordingly, service innovations can function as signals transmitted from provider to consumer, which consumers must interpret and evaluate (Spence, 1974). Their interpretations then shape subsequent beliefs and behaviors (Spence, 1974), making signaling theory a valuable framework for understanding consumer judgment of service innovativeness, which can be seen as an interpretation of service innovation.

### 1.1.6 Service innovativeness

One way to understand consumers' view of service innovations is by considering how consumers interpret it in terms of service innovativeness. Service innovativeness can be defined as a consumer's evaluation of the meaningfulness and novelty of a service compared to its alternatives (Mu et al., 2018; Zolfagharian & Paswan, 2009). It can draw consumers' attention and create a competitive advantage, thereby protecting firms from failure (Akgün et al., 2016; Leckie et al., 2017). Through differentiation and adaptation to new needs, service innovativeness increases the loyalty of consumers but also creates opportunities for providers to enter new markets (Akgün et al., 2016; Leckie et al., 2017; Liu, 2013). Thus, it is of strategic importance to have consumers perceive services as innovative, especially when considering service innovations that require high investments, as the potential financial losses from those are greater (Humphries, 2018). Arguably, leveraging service innovativeness has become even more important now, as digital technologies play a key role in service provision. Traditionally, innovativeness is associated with technological novelty (Rubera, 2015). While the connection with technology is more prevalent in the literature concerning an organization's view of innovation (Garcia & Calantone, 2002), the word "innovativeness" itself has historically had technological connotations in consumers' minds (Shams et al., 2015). Yet, research on service innovativeness considering technology is scarce (excluding Dotzel et al., 2013), especially research that considers the role of AI. Much of the existing literature concerns product innovativeness (novelty and radicalness of innovations), sometimes including services under the product umbrella term for tangible goods and intangible services (e.g., Avlonitis et al., 2001; de Brentani, 1989; Garcia & Calantone, 2002). Building knowledge of service innovativeness on product-oriented literature, especially in the case of technology-based innovations, is in line with the assimilation approach to service innovation

(Droege et al., 2009). Such an approach accommodates service-specific attributes (intangibility, heterogeneity, perishability, and inseparability) to a limited extent. Yet, trying to account for these distinct attributes and following the demarcation perspective, there is a need for further development of the concept of service innovativeness, which further emphasizes the need to deepen the understanding of how consumers perceive innovativeness.

In summary, service innovations, especially enabled by digital technology like AI, are reshaping the service landscape and offering new avenues for profitability and differentiation (Dotzel et al., 2013; C. Feng et al., 2020). However, some service innovations do not succeed in delivering the anticipated benefits and thus suffer commercial failure. Considering consumers' evaluations of service innovation may help firms reduce the risk of failure (Kurtmollaiev et al., 2022). Evaluation in the form of service innovativeness can become a crucial differentiator, enabling the service to stand out from the competition and catch the interest of consumers. Yet, service innovativeness is rarely studied, and its understanding is often restricted by conceptualizing it based on a theoretical foundation coming from product innovativeness, which may not fully capture the unique characteristics of services.

## 1.2 Purpose and research questions

Given the importance of service innovativeness for service firms, together with a limited understanding of the concept from a theoretical perspective, especially concerning AI-enabled service innovations as a source of service innovativeness, I state the following aim: *The purpose of the present dissertation is to advance the understanding of service innovation and service innovativeness and to explore the potential role AI plays in altering this understanding*. To achieve this aim, I focus primarily on answering three research questions.

Service innovation refers to a firm's implementation of novel service offerings or delivery methods (Gustafsson et al., 2020). However, not every change in offering that a firm considers service innovation is perceived by consumers as innovative (Zolfagharian & Paswan, 2009). Such misalignment is especially problematic in the case of services, as, unlike tangible goods, they tend to be characterized by experience and credence attributes (Alford & Sherrell, 1996). Assessment of experience attributes can only be done during or after consumption, and credence attributes may be impossible to judge even after consumption (Darby & Karni, 1973; Nelson, 1970). Both experience and credence attributes are especially difficult for consumers to assess when evaluating a service innovation (Zeithaml et al., 1988). With the scarcity of concrete service attributes on which to base the judgment, it is even harder for consumers to evaluate service innovativeness, as service innovativeness is already an abstract characteristic. Thus, to better understand the concept of service innovativeness, I wish to consider the following question:

**Q1:** How is service innovation related to service innovativeness?

Most research on innovativeness has focused on products, where consumer responses are relatively more predictable due to the tangibility of offerings (Garcia & Calantone, 2002). Consumer responses include various consumer reactions to behaviors or characteristics of firms, products, or services. Commonly discussed consumer responses are satisfaction (Fitzsimons, 2000; Martínez & Pina, 2010) and willingness to pay or adoption (Liljander et al., 2006; Sadik-Rozsnyai & Bertrandias, 2019). As services rely mainly on credence and experience attributes (Zeithaml et al., 1988), consumer responses may vary more significantly than in the case of products. Without readily accessible search attributes to use in the evaluation of the service, consumers' responses are greatly affected by their expectations and experiences (Berry et al., 2006; Grazzini et al., 2023). For firms to leverage service innovativeness to influence consumer behavior, it is essential to understand how consumers respond to service innovativeness. Thus, I consider the following question:

**Q2:** How is service innovativeness related to consumer responses?

Finally, while the first two research questions primarily seek to address the first part of the aim of the dissertation by enhancing the understanding of service innovativeness, the final research question considers how AI challenges the developed understanding. AI introduces both opportunities and challenges in service innovations. Enabling dynamic, personalized, and emotionally responsive services, AI reshapes the understanding of service innovations, making them more social and responsive than many of the existing service innovations yet more self-sufficient and accessible than the usual services (Huang & Rust, 2021; Holthöwer & van Doorn, 2022). However, with AI still in its infancy in service research, there is limited knowledge as to whether or how AI-enabled service innovations might differ from what we traditionally have viewed as service innovations. Our knowledge remains particularly limited regarding the consumer perspective on service innovativeness and the influence of AI as an enabling technology for such innovations. Thus, the final research question seeks to unravel the following:

**Q3:** How does the use of AI affect the relationships among service innovation, service innovativeness, and consumer responses?

Guided by the overall aim, including the three research questions, this dissertation discerns service innovations, service innovativeness, and the role of AI in services. Subsequently, the dissertation synthesizes this discussion into a conceptual framework based on signaling theory, which integrates knowledge from the appended papers.

## 1.3 Appended papers' contributions to the dissertation

The thesis comprises five papers that focus on different aspects of the purpose and strive to help answer the research questions. Table 1 presents the relationship of the papers with the research questions and their contributions.

***Table 1**. Contribution of the papers*

| ***Paper*** | ***Focus*** | ***Paper's aim/ research questions*** | ***Main contribution to the dissertation*** | ***RQs addressed*** |
|---|---|---|---|---|
| ***Paper 1*** | Innovativeness of various kinds, including service innovativeness and its different conceptualizations | What distinct types of innovativeness have been used in the literature? Which key characteristics help distinguish between the identified innovativeness concepts? How are the different innovativeness concepts interrelated? What gaps exist in the extant literature on innovativeness? | Discuss the relationship between service innovativeness and adoption, while considering partially uncovering different conceptualizations of service innovativeness. | Q2 |
| ***Paper 2*** | Importance of consumer perspective on service innovations and the benefits of Swedish Innovation Index | Aim at understanding the importance of consumer perspective in judging service innovativeness and the practical implications of it. | Discuss link between service innovations and service innovativeness and between innovativeness and relative attractiveness | Q1 and Q2 |

| | | | | |
|---|---|---|---|---|
| ***Paper 3*** | Service innovations and service innovativeness and its influence on relative attractiveness | How do different service innovation dimensions influence_service innovativeness?<br>Do COVID-imposed innovations mediate the relationship between service innovativeness and relative attractiveness? | Provide a model linking service innovations with service innovativeness and innovativeness with relative attractiveness | Q1 and Q2 |
| ***Paper 4*** | Impact of AI's social presence on service innovativeness and satisfaction | Aim at understanding how the social presence of service robots influences satisfaction in service encounters with service robots. | Provide a model linking AI-enabled service innovations (social presence of the robot) with service innovativeness and satisfaction | Q1, Q2, and Q3 |
| ***Paper 5*** | Impact of AI's intelligence on satisfaction and customer behavior | Aims to explore how users respond to and use AI-enabled services, thereby contributing to a deeper understanding of user interactions with various types of intelligence. | Discuss consumer responses, mainly adoption and satisfaction, to AI-enabled service innovations | Q1, Q2, and Q3 |

As presented in Table 1, each of the appended papers contributed to the purpose and the research questions differently. Paper 1 is a literature review that links various types of innovativeness concepts. In this paper, I obtain a greater understanding of the concept of service innovativeness and its different conceptualizations. The paper additionally contributes to the relationship between service innovativeness and consumer responses, with a focus on adoption. Paper 2 introduces the model from the Swedish Innovation Index (SII), linking various dimensions of service innovation, service innovativeness, and relative attractiveness. Paper 3 empirically investigates the relations discussed in Paper 2, adds the theoretical concepts of imposed service innovation, and considers how the dynamics of relationships differ depending on the sector of the service industry. Paper 4 is more focused on AI—in the embodied form of a robot—and its role in how consumers judge service innovativeness. It contains an empirical investigation of how social presence impacts service innovativeness and, subsequently, customer satisfaction. Finally, Paper 5 is empirical and discusses AI-enabled service innovations. It focuses especially on the impact of AI-enabled service innovations on consumer responses, such as adoption and customer satisfaction.

## 1.4 Contributions of the thesis

By examining how service innovation, service innovativeness, and consumer responses are linked, this dissertation seeks to contribute to the service literature, mainly the area of service innovation and service marketing. Additionally, by exploring how the studied relationships are influenced by AI, I address recent calls for research into the evolving role of technology in service delivery (Hollebeek et al., 2019). This dissertation makes three primary contributions.

First, the notion of service innovativeness is not widely used or well established in the service and marketing literature. As I noticed while reviewing the literature, only a few articles (such as Mu et al., 2018; Zolfagharian & Paswan, 2009) employ this concept. Yet, service innovativeness has the potential to differentiate the provider and contribute to the success of service innovation (Akgün et al., 2016; Leckie et al., 2017). At the same time, applying insights from product innovativeness directly to services risks conceptual confusion due to not accounting for service characteristics. This oversight may obscure the concept's role and place within broader theoretical relationships. Thus, the contribution lies in delineating the nature of the concept and its use in the literature and in further enhancing the understanding of service innovativeness by analyzing its relationship with service innovation and consumer responses.

Second, I apply signaling theory to discuss the mechanisms behind the relationships among service innovation, service innovativeness, and consumer responses. Although signaling theory is well established in service research and marketing (Aronson et al., 2025; Boulding & Kirmani, 1993; Rao et al., 1999), it has not been used extensively in the context of service innovation. By employing signaling theory, I offer both theoretical and empirical insights into how service innovation, indirectly through service innovativeness, affects consumer responses. Findings suggest that service innovation indeed signals service innovativeness, yet the strength of the signal depends on the degree of change and the signaling environment. Service innovativeness was found to be related to consumer responses such as adoption, satisfaction, or relative attractiveness. However, the valence of this relationship differs, showing the complex nature of the relationship between service innovativeness and consumer responses.

Third, AI has only recently become a service research priority (Ostrom et al., 2021). Thus, there is limited knowledge on how consumers interpret and respond to the use of AI in service innovations. I contribute to the growing research on AI in services by exploring how AI-enabled service innovations differ in their signaling effects and consumer responses. Namely, I conclude that for AI-enabled service innovations, service innovativeness is positively related to satisfaction. However, the relationship is negative with adoption, which is opposite for other service innovations. Thus, the findings call for caution in utilizing previous findings on service innovation for AI-enabled service innovations.

# 2. Theoretical background

## 2.1 Service innovation

### 2.1.1 Conceptualization of service innovation

Service innovation is the focus of several literature reviews that strive to deepen the understanding of the service innovation concept (Gustafsson et al., 2020; Snyder et al., 2016; Witell et al., 2016). One of the reasons behind the frequent reviews is the variety of conceptualizations leading to conceptual multiplicity (Gustafsson et al., 2020; Snyder et al., 2016). Indeed, there are many definitions of service innovation. For instance, Storey et al. (2016, p. 527) define service innovation as "the development of new or enhanced intangible offerings that involve the firm's performance of a task/activity intended to benefit customers." Other definitions state that service innovation is "new and/or improved service offerings, service processes, and service business models" (Ostrom et al., 2010, p. 5). To navigate this conceptual diversity, scholars have proposed several distinguishing criteria. Building on Witell et al. (2016) and Snyder et al. (2016), one can conceptualize service innovation considering 1) whether service innovation is a process or outcome, 2) how and for whom value emerges, and 3) who service innovation is new to. A variety of conceptualizations of service innovation are presented in Table 2, depicting how scholars apply those differentiating criteria to build an understanding of the concept.

***Table 2**. An overview of definitions of service innovation*

| ***Source*** | ***Definition*** |
|---|---|
| *Giannopoulou et al. (2014)* | "A type of product innovation involving the introduction of a service that is new or significantly improved with respect to its characteristics or to its intended uses." (p. 25) |
| *Breunig et al. (2014)* | "New service experience or service solution that consists of one or several of the following dimensions: a new service concept, new customer interaction, new value system/business partners, new revenue mode or new organizational or technological service delivery system." (p. 46) |
| *Enz (2012)* | "The introduction of novel ideas that focus on services that provide new ways of delivering a benefit, new service concepts, or new service business models through continuous operational improvement, technology, investment in employee performance, or management of the customer experience." (p. 187) |

| | |
|---|---|
| *Gallouj and Weinstein (1997)* | "Any change affecting one or more terms of one or more vectors of characteristics (of whatever kind–technical, service or competence)." (p. 547) |
| *Skålén et al. (2014)* | "The creation of new value propositions by means of developing existing or creating new practices and/or resources, or by means of integrating practices and resources in new ways." (p. 137) |
| *Storey et al. (2016)* | "The development of new or enhanced intangible offerings that involve the firm's performance of a task/activity intended to benefit customers" (p. 527) |
| *Gustafsson et al. (2020)* | Service innovation is "a new process or offering that is put into practice and is adopted by and creates value for one or more stakeholders." (p. 112) |

The literature commonly distinguishes between service innovation viewed as a process or outcome. The process refers to a new service development, while the outcome refers to a new service offering (Witell et al., 2016). Yet, it is not always explicit whether one refers to the innovation process or its outcome or does not separate them (Carlborg et al., 2014; Toivonen & Tuominen, 2009). When treating service innovation as a new service development, it is defined as "the process of devising a new or improved service, from idea or concept generation to market launch" (Biemans et al., 2016, p. 383). This approach is oriented toward the firm developing the innovation, which may never be introduced to the market or observed by consumers. Thus, in consumer-oriented literature, service innovation is often conceptualized as an outcome (Lusch & Nambisan, 2015; Michel et al., 2008; Witell et al., 2016). An exemplary definition of service innovation following such a conceptualization is proposed by Giannopoulou et al. (2014, p. 25). It states that service innovation is "[a] type of product innovation involving the introduction of a service that is new or significantly improved with respect to its characteristics or to its intended uses."

Service innovation conceptualizations distinguish among value creation for the consumer, for the firm introducing the innovation, and for other stakeholders. Some definitions adopt a firm-centric view aligned with Schumpeterian innovation theory, emphasizing economic benefits for the innovator (Schumpeter, 1934). For example, Toivonen and Tuominen (2009, p. 893) specify that "service innovation (…) is put into practice, and (…) benefit[s] (…) the organization that has developed it." However, since the benefits for a company are created by providing value for consumers through satisfying their needs, many definitions expand to include value creation for users (Utterback & Abernathy, 1975). Defining service innovation based on economic benefits for the provider overlooks the role of service innovation in creating social value. Social innovations aimed at improving public welfare may not pursue profit (Bhatt & Altinay, 2013) but still contribute significantly to society (Phills et al., 2008). More inclusive definitions, such as that proposed by Gustafsson et al. (2020), recognize that service innovation can create value for a range of stakeholders beyond the service provider. This definition is inclusive in its understanding of innovation; at the same time, it agrees that innovation comes from an organization and is put into practice, indicating the difference between innovation and invention.

Finally, a defining characteristic of service innovation is newness. However, scholars disagree on exactly what constitutes “new.” At its core, “new” suggests a difference between the reference point and the current state of things, which implies change, a key characteristic of a service innovation (Gustafsson et al., 2020). However, defining what is “new” requires specifying the perspective from which change is evaluated. Scholars commonly distinguish among innovations that are new to the firm, new to the market, or new to the world (Snyder et al., 2016). New-to-the-world indicates the most radical solutions (Snyder et al., 2016). When innovation is new to the market (or customers), it often entails a high degree of radicalness (Droege et al., 2009) and requires greater effort from consumers to adopt the given innovation (Thakur & Hale, 2013). The new-to-the-firm category leans more toward incremental change (Savas-Hall et al., 2020). Yet, there are different views, as some authors also consider new-to-the-world to be more radical than new-to-the-market (Witell et al., 2016). Some argue that new-to-the-firm should not imply service innovation, as it suggests that firms that copy or adopt innovations should be considered innovators (Toivonen & Tuominen, 2009).

In this dissertation, I build on the definition of Gustafsson et al. (2020), while slightly modifying its intended meaning by adding several specifications. I conceptualize service innovation as “a new process or offering that is put into practice and is adopted by and creates value for [consumers]” (Gustafsson et al., 2020, p. 112). Since newness is relative to the actor judging it (Toivonen & Tuominen, 2009), in this dissertation, I focus on consumers’ view on service innovations. Thus, the chosen definition takes their evaluation into perspective. Moreover, since consumers usually observe the service and its provision rather than take part in the development of a new service, the chosen definition stresses the outcome perspective on service innovation.

### 2.1.2 Dimensions of service innovation

Service innovation is often defined in terms of service innovation's core characteristics, such as process/outcome, stakeholders, and newness. (Snyder et al., 2016). Alternatively or additionally, service innovation can be described as a multidimensional concept (den Hertog et al., 2010; Martin et al., 2016; Snyder et al., 2016). As Snyder et al. (2016, p. 2402) note, "[a] service innovation may involve changes in several dimensions of an existing service," and therefore, "using changes in dimensions to define service innovation frequently depends on multiple changes to an existing offering" (see examples in Table 2). Since the definitions of service innovation tend to be broad, they may not always allow for the identification of service innovations in practice (Snyder et al., 2016). Thus, it is common to combine a general definition and a dimensional perspective in conceptualizing service innovations (see Aas & Petersen, 2011). In this dissertation, I focus on dimensions of service innovation that are observable and identifiable by consumers**,** drawing on dimensions frequently used in existing research (see den Hertog et al., 2010).

Service innovation is often understood by determining which dimension has changed or is new in comparison to existing services (Toivonen & Tuominen, 2009). Conceptualizations of service innovation that contain uniform elements allow for comparative analysis, which is difficult to achieve in the highly heterogeneous service sector (Janssen et al., 2015). Additional benefits of adopting dimensional frameworks are that they reveal that firms have more room for innovation, as they highlight multiple possible areas for change (Snyder et al., 2016). Moreover, some dimensions may serve to gauge firms' performances (den Hertog et al., 2010).

While the multidimensionality of service innovation is well acknowledged in the literature, there is little consensus on which specific dimensions should be included (e.g., Bryson et al., 2012; Carlborg et al., 2013; Droege et al., 2009; Janssen et al., 2015). There are three main ways service innovation dimensions are addressed in the literature: the most straightforward classification suggested by Sirilli and Evangelista (1998) and the *Oslo Manual* (2018), which delineates two dimensions: product (service offered) and process (service delivery or development). However, these dimensions were formulated for product innovation, with an initially strong focus on technology. In the context of service innovation, where offerings are often intangible and co-produced, distinguishing between these dimensions can be challenging (*Oslo Manual*, 2018). Nevertheless, international statistical organizations (OECD or EUROSTAT) and national statistical offices widely use this differentiation to obtain data on service innovation from the industry, similar to how it is done for manufacturing firms on product innovation (Sirilli & Evangelista, 1998). Such information across different countries and sectors is a useful source of data, allowing for a fuller picture of the state of different sectors and the overall importance of service innovation for the economy (Djellal & Gallouj, 1999; Sirilli & Evangelista, 1998).

The second approach is organizational, as it also primarily considers the service provider. Its most prominent examples are the dimensions proposed by den Hertog (2000): service concept, client interface, service delivery system, and technological options. Later, den Hertog et al. (2010) incorporated two additional dimensions: the business partner and revenue model. These dimensions are widely embraced and often serve as the basis for other researchers, such as Agarwal and Selen (2011) and Lin (2013).

Finally, an entirely different dimensional approach to service innovation builds on Lancaster's definition of a product as a set of characteristics (Lancaster, 1966; Snyder et al., 2016). Gallouj and Weinstein (1997) use the Lancasterian approach, as they include characteristics such as provider competencies, provider technology, outcome characteristics, and customer competencies. While the first three dimensions align broadly with other models, the inclusion of customer competencies is unique. Den Hertog et al. (2010) and Lin (2013) acknowledge the customer but in a more passive role than Gallouj and Weinstein (1997).

Given the interest in consumer judgment of service innovation, the current dissertation synthesizes these three approaches by focusing on dimensions that are visible to consumers—those occurring "above the line of visibility" (Bitner et al., 2008; Shostack, 1984). This poses a challenge, as previous approaches have focused on service innovation dimensions from an internal perspective. Building on Kurtmollaiev et al. (2022), one can consider four overarching dimensions: delivery, offering, servicescape, and interaction. The offering comes from den Hertog et al.'s (2010) service concept, or what Sirilli and Evangelista (1998) call a product. It includes changes to the tangible and intangible elements of the new solution offered, meaning that if the service centers around the tangible product, changes in the given product are also covered by the offering dimension. The delivery dimension focuses on changes to the delivery of tangible and intangible products for the company and was used by Sundbo et al. (2007), Lin (2013), and den Hertog et al. (2010). Both organizational and technological aspects may be involved in service provision (den Hertog et al., 2010; Lin, 2013). However, I consider only the delivery aspects, which are visible to consumers. A servicescape is probably the closest to what Zolfagharian and Paswan (2009) call internal and external facilities. It includes changes in both virtual and physical service environments, and these are often the first things to be noticed by consumers (Bitner, 1992). The last dimension, interaction, accounts for the role of the consumer and the nature of the interaction between the provider and the consumer. Interaction is not only considered person-to-person contact but also self-service interfaces and any other touchpoint (den Hertog et al., 2010).

Technology is often specified as a separate dimension of service innovation, as done by den Hertog et al. (2010), Barrett et al. (2015), and Gallouj and Weinstein (1997). However, considering the importance of technology in enabling service innovations (Hollebeek et al., 2021), viewing technology as a service innovation dimension may lead to an overlap between the different dimensions. For example, a chatbot can be classified as a change in technology but also as a change in interaction. Technology facilitates various changes that are not introduced for the sake of technology only, and so those changes are reflected in other dimensions. Service innovations are both technological and non-technological, which means that not all innovations need to involve technological advancement (Sebastiani & Paiola, 2010). Hence, technology is sometimes treated as an enabler of service innovations rather than as a discrete dimension (see Chaudhuri et al., 2021; Dotzel et al., 2013; Tuunanen et al., 2023). Improvement or change in technology is rarely the aim in itself, and value comes from what the technology affords (Majchrzak et al., 2016). This may be improving interactions with consumers or easing the delivery process. In this dissertation, I do not treat technology as a dimension but as an enabler that can affect any of the service innovation dimensions. In many AI examples, service innovation can influence most dimensions, changing interactions by talking with a bot, adjusting delivery by being available via phone, and so on. Instead, this can only be classified as a change in the technology dimension. Thus, I do not consider technology a dimension, as classifying change into technology when it simultaneously affects other dimensions hinders a more nuanced understanding of the role technology plays in service innovation.

## 2.2 Service innovativeness

### 2.2.1 Conceptualization of service innovativeness

Innovativeness itself is not a new concept. It is broadly used to consider product innovativeness and organizational innovativeness (Garcia & Calantone, 2002; Kunz et al., 2011). Product innovativeness is perhaps the most closely related to the focal construct of service innovativeness.

Product innovativeness has been of interest to many scholars and practitioners, as it is often linked with product success in a market (Kleinschmidt & Cooper, 1991; Szymanski et al., 2007). The concept is generally understood as the degree of newness of the product (Garcia & Calantone, 2002). Some, especially more recent, definitions also include usefulness or meaningfulness (Szymanski et al., 2007). Since product innovativeness can be seen as a new product's capacity to change a firm's resources, skills, technologies, and strategies, it has been mostly considered by the firm that introduces it (Garcia & Calantone, 2002; Szymanski et al., 2007). Some authors, in their discussions on product innovativeness, also tried to account for the service or to discuss mainly service rather than product (e.g., Avlonitis et al., 2001). Yet, product innovativeness is usually oriented toward physical products with a strong focus on technology (Garcia & Calantone, 2002; Henard & Szymanski, 2001; Kleinschmidt & Cooper, 1991).

Purely service innovativeness is only discussed in a limited number of studies and is not well scrutinized. Sometimes, service innovativeness is focused on the outcome of innovative activities of firms and, as such, builds on the concept of product innovativeness (e.g., Akgün et al., 2016; Cheng & Huizingh, 2014; O'Cass & Carlson, 2012). In such a case, one considers the artifact—the outcome of human actions that is acted upon—and so innovativeness is focused on external characteristics. Therefore, service innovativeness may be described as the extent to which a new or enhanced service offering is novel, meaningful, and different from available alternatives (Heirati & Siahtiri, 2019; Leckie et al., 2017; Spieth & Schneider, 2016). This can be considered a product-level conceptualization of service innovativeness. Despite calling it the product level, I do not equate the service to a tangible good; however, in line with conventional logic, services are intangible products or outcomes of the firm (Barras, 1986; Vargo & Lusch, 2008). Zolfagharian and Paswan (2009) claim that service innovativeness is depicted by the degree of change in the dimensions of intangible service offerings. This suggests that service innovativeness is not only connected to changes in technology, design, or the amount of R&D expenditure, as in the case of product innovativeness (e.g., Ali et al., 1995; Calantone et al., 2006), but also accommodates intangible aspects of service, which indicates the move towards the more visible separation of service and tangible product innovativeness.

Other conceptualizations of service innovativeness borrow from organizational innovativeness, which is understood as the tendency and capacity to develop new products and services (Calantone et al., 2002; Garcia & Calantone, 2002; Hult et al., 2004). This definition focuses on the actor, and innovativeness considers "what it can do" over "what it is," as in the case of product-level service innovativeness. Consequently, several authors (Dotzel et al., 2013; Hollebeek & Rather, 2019; Lin, 2019) define service innovativeness as a firm's capability to launch service innovations. This type of conceptualization of service innovativeness is also often used in service research under the term firm innovativeness (Keiningham et al., 2024; Kunz, 2024).

Furthermore, the conceptualization of service innovativeness considers the evaluation perspective on innovativeness by specifying who is evaluating service innovativeness. It is customary to view any concept, including service innovativeness, determined by the customer as perceived (e.g., McLeay et al., 2021; Zolfagharian and Paswan, 2009). Therefore, the term "perceived service innovativeness" is applied when the actor who is an outsider, not the creator of the innovation under investigation, judges service innovativeness. In most cases, the customer is the outside actor determining service innovativeness (e.g., McLeay et al., 2021; Omar et al., 2021; Zolfagharian & Paswan, 2009). Consideration of the consumer perspective on service innovativeness seems to be in line with a service logic that stresses the customer's role in value creation (Grönroos & Gummerus, 2014).

However, service innovativeness can be evaluated by the firm developing the service innovation. Here, firms assess the service innovativeness of their own services or their own service innovativeness. One can call it intrinsic service innovativeness, as it is internally evaluated. This understanding of service innovativeness is also widespread in the literature (e.g., Akgün et al., 2016; Durmusoglu et al., 2018; R. P. Lee et al., 2009). In Table 3, one can see different service innovativeness definitions that allow me to build the classifications discussed in this section.

***Table 3.*** *An overview of definitions of service innovativeness*

| ***Source*** | ***Definition*** | ***Classification*** |
|---|---|---|
| *R.P. Lee et al., 2009* | "Hospital's ability to adopt and provide a variety of healthcare services to customers in a timely manner so as to reflect its tendency to place greater importance on more recent services." (p. 398) | Intrinsic firm level |
| *Zolfagharian & Paswan, 2009* | "The consumer's evaluation of the extent to which the dimensions of a service offering meaningfully differ from those of alternatives, real or imagined." (p. 156) | Perceived product level |
| *Dotzel et al., 2013* | "Organizational capability or propensity to introduce service innovations." (p. 259) | Intrinsic firm level |

| | | |
|---|---|---|
| *Liu, 2013* | "A measure of the potential discontinuity a product (process or service) can generate in the marketing and/or technological process." (p. 54, quote from Garcia and Calantone 2002, p. 113) | Intrinsic product level |
| *Melton & Hartline, 2015* | Degree of radicalness of the outcome of the NSD | Intrinsic product level |
| *Akgün et al., 2016* | "The extent or degree of differences and novelties built into the dimensions of intangible service offerings or the degree to which innovated, marketable service products are new to the firm or market." (p. 104) | Intrinsic product level |
| *Leckie et al., 2017* | "Service concept newness and relative advantage." (p. 71) | Perceived product level |
| *Durmusoglu et al., 2018* | "Overall innovative capability of introducing new products to the market, or opening up new markets, through combining strategic orientation with innovative behavior and process" (p. 925 quote of Wang and Ahmed, 2004, p. 304). | Intrinsic firm level |
| *Mu et al., 2018* | "Service innovativeness refers to the uniqueness or novelty of a service innovation to the market or user groups." (p. 72) | Perceived product level |
| *Keiningham et al., 2019* | "It is defined as the degree of newness or radicalness of the product or service." (p. 374) | Perceived product level |
| *McLeay et al., 2021* | "A customer's receptiveness and predisposition to a service provider adopting new ideas and launching new products and/or services […] that result in 'novel, creative, and impactful ideas and solutions' (Kunz, Schmitt, & Meyer, 2011, p. 817)" (p. 106) | Perceived firm level |
| *Omar et al, 2021* | "Consumer's perceptions regarding retailers' capability to offer new selling methods, new service delivery process, and creative business value systems" (p. 359) | Perceived firm level |

Building on these classifications, one can distinguish four distinct conceptualizations of service innovativeness that exist in the literature, as presented in Figure 1. First, different conceptualizations differ, depending on whether a service is an actor or an artifact. Second, they can be distinguished by considering who judges the change. These differences are also mirrored in their positions in the nomological network in relation to service innovation. For instance, intrinsic firm-level service innovativeness is a description of a firm's capability to introduce service innovations (Dotzel et al., 2013; Durmusoglu et al., 2018) and thus can be seen as an antecedent of service innovation. However, intrinsic and perceived service innovativeness at the product level is a consequence of service innovation, as the artifact needs to exist to possess any characteristic or quality. Finally, perceived firm-level service innovativeness, unlike its intrinsic alternative, is less actively connected to service innovation, as consumers do not possess inside information and they need to obtain assurance of such quality from the company. Thus, rather than acting as an antecedent, it acts as a consequence of service innovation, as a firm needs to launch an innovation to be seen as innovative by consumers (Kunz et al., 2011).

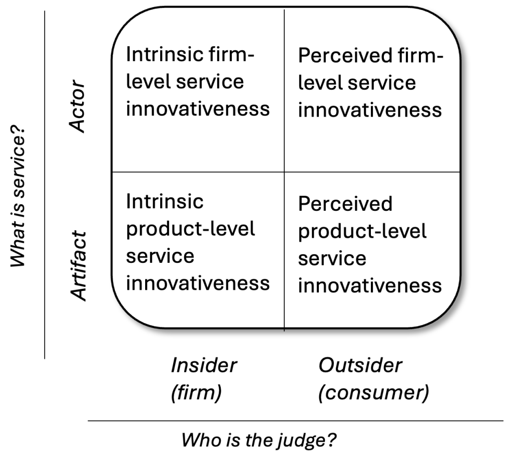


***Figure 1.*** *Service innovativeness matrix*

As this thesis considers the view of consumers, I adopt perceived service innovativeness; yet for brevity, I omit the word "perceived" when referring to the concept. While firm-level service innovativeness is similar to firm innovativeness when used in service research (Keiningham et al., 2024; Kunz, 2024), product-level service innovativeness is harder to capture with the alternative concept. Especially since the use of product innovativeness (e.g., Liu, 2013), while convenient, does not account for the service characteristics that separate it from a tangible product, such as perishability, intangibility, inseparability, and heterogeneity (Lovelock & Gummesson, 2004). Thus, product and service innovativeness are not always appropriate to be equated, especially as "service innovativeness shows the extent or degree of differences and novelties built into the dimensions of intangible service offerings" (Akgün et al., 2016, p.104). Thus, I believe that service innovativeness is the customer's or, in my case, the consumer's evaluation of the meaningfulness and novelty of a service in comparison to alternatives (Mu et al., 2018; Zolfagharian & Paswan, 2009). By meaningfulness, one can understand aspects like fulfillment of needs or functional relevance to potential consumers (de Brentani, 1989; Stock & Zacharias, 2013). In other words, the service needs to be able to bring value to consumers to be considered innovative. However, this work uses both product-level and firm-level service innovativeness, where firm-level innovativeness can be defined as the consumer's evaluation of the firm's capability to introduce service innovations (Dotzel et al., 2013).

### 2.2.2 Service innovativeness compared with similar concepts

Existing service research uses several concepts that bear a strong resemblance to (service) innovativeness, namely newness, novelty, and creativity. Creativity in the service context can be defined as "the extent to which a new product is novel and differs from its competing alternatives" (Ameen et al., 2024, p. 1919). In this example, the author refers to both the tangible good and the service as a product. While this conceptualization of service creativity exists, such understanding is not common. Most of the service literature (Korzynski et al., 2019; T. Lee et al., 2021; Sigala & Kyriakidou, 2015) defines creativity as the ability of a firm or, in most cases, an individual. For example, according to T. Lee et al. (2021, p. 2), "Service creativity refers to the capabilities of employees to generate useful and novel offerings to serve customers." Creativity is also sometimes considered a characteristic of innovative service firms (Kunz, 2024) and an antecedent of service innovation (Sigala & Kyriakidou, 2015). Thus, it concerns the actor, employee, or firm rather than the outcome, which is the service.

Novelty and newness are rarely differentiated from each other and refer to the quality of being new (Truong, 2013). At times, one is used to define the other; for example, "newness refers to novelty, originality, or uniqueness" (Stock & Zacharias, 2013, p. 518). In cases where researchers strive to distinguish between novelty and newness, newness is understood more as recency, which does not bring any other benefit, while novelty confers substantive benefit (e.g., Jie & Li, 2022). However, it could be argued that the literature most commonly, while not differentiating, considers newness and novelty to be more than simple chronological recency (e.g., Talke et al., 2009; Truong, 2013; Wang et al., 2022).

"Newness is one of the most salient attributes of innovations" (Truong, 2013, p. 132) and the same applies to innovativeness. In line with the definition adopted in the present work, service innovativeness consists of two parts: novelty and meaningfulness. Stock and Zacharias (2013) discuss these two parts as having opposite associations for consumers, as novelty is connected with uncertainty and risk and thus negative associations, while meaningfulness is charged positively, as it promises beneficial outcomes to the consumer. This definition distinguishes service innovativeness from service newness or novelty. However, there is also a positive valence associated with innovativeness that makes the distinction clearer (see Min, 2022). Stauffer (2015) further argues that innovativeness is "valuable novelty," as it goes beyond being new but is also valuable for the consumer. This positive charge associated with innovativeness comes from the meaningfulness captured alongside the novelty in the concept. Thus, innovativeness, while related and close to the concepts of novelty and creativity, is a distinct concept.

## 2.3 Artificial intelligence

### 2.3.1 AI in services

Consideration of digital technologies in consumer services can be somewhat challenging when taking the consumer view into account, as consumers see only what is above the line of visibility (Bitner et al., 2008; Shostack, 1984) and do not have access to inventory management systems or other business operation software used by the provider. In the case of consumer services, research often addresses technologies using terms such as self-service technologies (Meuter et al., 2000, 2003), e-services (Bressolles et al., 2014; Roger-Monzó et al., 2015), digital services (Kwong & Park, 2008; Shaikh et al., 2020), and technology-enabled services (Makarem et al., 2009; Schuster et al., 2015). However, not all of these terms can be universally equated with digital technologies. For instance, self-service technology is virtually anything that allows consumers to be more responsible for service delivery (Meuter et al., 2000, 2003), such as IKEA's self-service warehouse. Even when considering service innovations, one can distinguish between technological and non-technological service innovations (Samuelsson, 2023). Technological service innovations are referred to as "technological" due to the use of new knowledge or technology (Samuelsson, 2023). Similarly, Barrras (1986), in the early stages of service innovation research, stressed the importance of various technologies, of which information technology is only a part. However, over the last 40 years (Barras, 1986; Samuelsson, 2023), authors have continued to stress the predominant use of digital technologies in technological service innovations. Similarly, self-service technologies are mainly delivered through telephone-based interfaces (interactive voice response systems), direct Internet-based interfaces, interactive freestanding kiosks, and video or CD (non-interactive self-service) (Meuter et al., 2000). Thus, digital technology often enables technological changes in services. The most recent digital technology that greatly impacts service and is the main source of service innovations is AI (Rust & Huang, 2014). Unlike other previously mentioned technologies, AI can operate autonomously (Belanche et al., 2021; De Keyser et al., 2019), meaning that it can make decisions and act independently from a human operator or a predefined scenario.

AI can be defined as computer systems that possess the ability to perform complex tasks requiring human-like mental abilities (Makridis & Mishra, 2022; NASA, 2024; Shankar, 2018). Such tasks often require considering several aspects or performing a number of actions; thus, reasoning, decision-making, and literacy, which are originally cognitive skills of humans, are necessary to perform these tasks. What distinguishes AI is its ability to learn and adapt; however, the degree of learning ability depends on its design or intended use (Huang & Rust, 2021). According to Bock et al. (2020), "Service AI" creates value as a technological configuration of internal and external service settings enabled by flexible adaptation through sensing, learning, and decision-making skills. Different tasks require these skills to different extents. Thus, Huang and Rust (2021) distinguish three types of AI that can fulfill different tasks—mechanical, thinking, and feeling intelligence—based on the degree of ability to learn and adapt. Mechanical intelligence has minimal learning and adoption skills, as it is mainly used for standardized, repetitive tasks, and so is suited more for repetitive tasks to benefit from efficiency and scale (Huang & Rust, 2021). Thinking intelligence learns from data and adapts, thanks to which it identifies patterns in some instances, understands the predefined context, and optimizes decision-making (Huang & Rust, 2021). Finally, feeling intelligence learns and adapts based on data that is contextual and individual specific; thus, it can recognize emotions and provide a sense of empathy and understanding to the users (Huang & Rust, 2021). While each type of AI can be beneficial to service, scholars pay special attention to feeling intelligence due to the interpersonal nature of many services (e.g., Bagozzi et al., 2022; Huang & Rust, 2024; Rust & Huang, 2021). While feeling intelligence is still in its early stages (Vorobeva et al., 2022), its development will threaten many work positions, depriving services of the real human interaction that some consumers look for (Kinch & Buell, 2025; Xu et al., 2024).

AI is repeatedly equated with robots, as they often possess a common core technology, which is AI (Wirtz et al., 2018). Rust and Huang (2021) distinguish between "embodied robots" and "embedded machines." Machines with a physical appearance are "embodied" and often called "robots," whereas machines without a physical body, such as chatbots or virtual assistants, are embedded (Rust & Huang, 2021). Robots often use AI, so they also exhibit attributes of human intelligence (Syam & Sharma, 2018). In such instances, AI is the "brain" of the physical embodiment. Thus, embodied and embedded AI share many commonalities. Both forms of AI have ability to provide customized services (Jörling et al., 2019) with a high degree of autonomy (Holthöwer & van Doorn, 2022) and human-like cognitive abilities (Makridis & Mishra, 2022), which are required to perform complex tasks (Huang & Rust, 2021).

Due to AI's abilities and characteristics that are similar to those of humans, the service literature often studies this resemblance in both tangible and intangible aspects. An important concept explored in the literature on AI is anthropomorphism - the extent to which consumers see AI as resembling humans (Blut et al., 2021). The resemblance may come from the anthropomorphic design, in which the robot possesses human-like visual features (see Bartneck et al., 2009; Belanche et al., 2021). However, consumers do not need embodiment to anthropomorphize AI. The way AI communicates in verbal form can also make AI more human-like and facilitate the anthropomorphizing of it (Crolic et al., 2022). This may lead to the uncanny valley effect, which links AI's strong resemblance to humans with discomfort (Kim et al., 2019; Mori, 1970). Yet, studies show ambiguous results of anthropomorphism on consumers, suggesting both positive (e.g., Blut et al., 2021; So et al., 2023) and negative effects (e.g., Crolic et al., 2022; Kim et al., 2019; Mende et al., 2019). Thus, researchers also focus on another human-resembling quality, mainly the social presence, which refers to consumers considering AI to be a social entity (van Doorn et al., 2017). Both anthropomorphism and social presence are connected, yet their importance differs depending on AI's application in service; social presence is paramount when considering the interactional role of AI in service (van Doorn et al., 2017).

### 2.3.2 AI as an enabler of service innovations

Service research highlights the need for AI to fulfill more feeling tasks to serve consumers (Bagozzi et al., 2022). Van Doorn et al. (2017) argue that in service settings, AI creates value mainly through active engagement with consumers as social actors, for example, through chatbots or voice-based assistants (De Keyser et al., 2019). Thus, AI is visibly changing the interactional dimension of service innovation. Yet, AI is not always obvious and social, especially since even feeling tasks delivered by AI can be hidden in, for example, recommendation systems (Esmaeilzadeh & Vaezi, 2022). Due to the characteristics of knowledge, work services based on AI are mostly provided with no physical labor (Xiao & Kumar, 2021). Such AI services are often not visible on the frontline, yet they still shape the social and economic landscape and have a paramount influence on consumer behavior (Esmaeilzadeh & Vaezi, 2022).

While it may be less straightforward, AI can lead to changes not only in the interaction dimension of service innovation but also in the offering, delivery, or servicescape dimensions. Changing interactional partners to AI often also includes changes in the service delivery process, since AI is becoming responsible for the service delivery, as in the case of implementing robots as frontline employees in hotels or restaurants (De Keyser et al., 2019; Wirtz et al., 2018). AI employed as an advisor at a bank (e.g., Flavián et al., 2021) changes the interaction as well as delivery, as service becomes automated and delivered by AI and via the consumer's phone or computer.

Even if AI is not an interactional partner, it can greatly affect service delivery, as with an AI skin cancer screening app that allows for self-screening instead of a human-delivered one (e.g., Gaube et al., 2024). Similarly, autonomous driving vehicle services change the way transportation services are delivered (Osburg et al., 2022). Robots preparing and delivering food and beverages to one's table provide another example of how AI can influence the delivery dimension of service innovation (Chang & Kim, 2022).

Offering is the next service innovation dimension that can be changed with the help of AI. An example of a change in offerings enabled by AI is the "anticipatory shipping" service introduced by Amazon, which anticipates what consumers may want and ships it before they even order it (Shankar, 2018). Thus, Amazon offers a service of anticipation of need or want that never existed before. Another example is a Swiss church that broadens its services by offering private theological discussion sessions with an AI-based hologram of Jesus (Kassam, 2024).

Finally, "[i]ncorporating AI and its enablers (e.g. drones, robots; [ …]) can drastically change the servicescape." (Bock et al., 2020, p. 327). In the case of the physical servicescape, the design of the embodiment of AI has the biggest impact, as robot design is a part of the servicescape, as considered by Chang and Kim (2022). AI without physical embodiment can impact virtual servicescapes. For example, L'Occitane uses AI to identify pain points on a mobile site and modifies the website and app based on it (Shankar, 2018).

AI serves as an enabler of innovation by creating changes in different service innovation dimensions. It is often not one dimension that is affected by change, as is visible in the aforementioned examples. Servicescape, delivery, interaction, and offering are closely connected, and one change often impacts several at once.

## 2.4 Signaling theory

Signaling theory provides a theory-based explanation of the relationships between the focal concepts of this dissertation and accounts for the mechanisms altering those relationships. The link between concepts such as service innovation and service innovativeness is often assumed, with little theoretical explanation beyond the empirical findings from previous research. Thus, with signaling theory, I aim to enrich this discussion, hoping its use in depicting relationships between service innovation, service innovativeness, and consumer responses extends beyond this dissertation and aids in predicting and testing more nuanced mechanisms and dependencies in focal relationships in future research. Other theories can assist in understanding the studied relationships. As my dissertation concerns the judgments of consumers, cognitive psychology offers, for instance, cognitive dissonance (Festinger, 1957) and schema theory (Piaget, 1952) to study perception creation and emotional reactions to the unfamiliar. Yet, theories from cognitive psychology, despite capturing the customer view in greater detail, fail to account for the role of the service provider. In signaling theory, both parties have different but equally important roles to play, and the process can hold only when both parties are present. While it is not the main focus of this dissertation, signaling theory can be seen as two-way communication in which the sender treats the receiver's response as feedback and adjusts the signal (Connelly et al., 2025). Thus, signaling theory is suitable for explaining the consumer judgment on service innovation without forgetting about the consumption context and the other partner in this interaction.

### 2.4.1 Basics of signaling theory

Signaling theory was developed by Spence (1973) and belongs to information economics; however, it has served to explain various phenomena in marketing (e.g., Boulding & Kirmani, 1993; Kirmani & Rao, 2000) and service research (e.g., Hoang et al., 2025; Ni & Sun, 2017). An example of the use of signaling theory in marketing is the study of Srivastava and Lurie (2001), who investigated price-matching refund policy as a signal stimulating price perception and resulting in the stoppage of alternative search depending on the cost of the search. Another example is Boulding and Kirmani (1993), who consider warranties a signal of quality for consumers and study how types of warranties influence the strength of the signal, depending on the firm's credibility bond. Akdeniz and Talay (2013), as well as Basuroy et al. (2006), discuss how external product-related cues, such as reviews, lead to monetary success, explaining that those cues signal quality, which pushes consumers to purchase. Studies that more directly address innovations and innovativeness, such as Micheli and Gemser (2016), discuss design innovativeness as a signal of quality, which produces financial benefits for a firm. Similarly, Pappu and Quester (2016) use brand innovativeness as a signal of quality, which leads to loyalty. Finally, Henard and Dacin (2010) discuss a firm's reputation for product innovation as a signal that ultimately leads to consumer engagement. Like the cases of those examples, the major benefit of the theory for this dissertation is its focus on dyadic interaction. Moreover, signaling theory allows me to bridge the realm of a firm with that of the consumer, as it lets me consider consumer reactions to the actions of firms, which is in line with this dissertation's advocacy for firms to understand their consumers' perceptions.

In brief, signaling theory considers how one actor conveys some information about themselves to another actor by means of signals that indirectly reveal the given information. This makes the theory simple but efficient in explaining various mechanisms (Connelly et al. 2011). Spence (1974) provides the following example of an employer considering profiles of work candidates to depict the theoretical mechanism: "The employer reads the education signal and predicts productivity with it. The result is a job or wage and salary offer." (p. 297).

One important assumption in signaling theory is information asymmetry between the involved parties, as signaling is a way of limiting asymmetry. Signals that provide information ultimately allow people to alter their judgments and make decisions (Spence 1974). Suppose that there is an information asymmetry between two parties. In this case, the party possessing better information can minimize the asymmetry by signaling the qualities and allowing another party to make an informed decision. However, signals are usually intentionally positive and do not only serve to minimize the information asymmetry (Connelly et al. 2011). The signaler may try to influence the other party by sending a given signal (Spence, 1973). Ultimately, signaling aims to have a positive influence on desired outcomes, such as trust or purchase (Micheli & Gemser, 2016; Wells et al., 2011).

Signalers are those individuals or organizations who possess information concerning an organization, product, or individual that is unavailable to others. Signals are actions or attributes that are proxies of the unobservable characteristics of signalers or signalers' offerings (Rao et al., 1999). While the signaler chooses how to send the signal (Connelly et al., 2011), the receiver is responsible for interpreting the received signal (Drover et al., 2018). The receiver is an external actor and, in this dissertation, a consumer. Consumers rely on signals, as they provide heuristics or help in the assessment of objects or companies when information about them is incomplete (Wells et al., 2011). Thus, "[b]ased on the signal, the receivers will make their own interpretation, update their prior beliefs, make inferences about those parameters, and then adjust their action" (Su & Rao, 2010, p. 666). For consumers to use the signal, it must be observable and costly (Aronson et al., 2025; Cabaleiro-Cerviño & Burcharth, 2020). Observability refers to being noticeable to receivers. Signal cost is one of the core aspects of signaling theory, as it assumes that consumers are "rational" and considers it financially unwise for a firm to signal quality that the firm does not possess (Kirmani & Rao, 2000). It is relatively easy for high-quality companies to use the ISO certificate to signal quality, as not much adjustment needs to be made to obtain the certificate. For low-quality companies, obtaining the ISO certificate will create a lot of costs, as they do not meet the standards and need to change and invest to reach the requirements of a certificate—so the signal is very costly for low-quality companies, and the cost may outweigh the potential benefits (Connelly et al., 2011). Additionally, signals need to be easy to understand and interpret, as complex signals may lead to consumers' misinterpretation, which can lead to less-than-optimal outcomes (Cabaleiro-Cerviño & Burcharth, 2020; Shahid et al., 2024). All those aspects of the signal—observability, cost, and clarity—add to what some authors call signal strength (Bafera & Kleinert, 2023; Deb, 2013; Prabhu & Stewart, 2001). Prabhu and Stewart (2001) claim, for example, that a deep price cut is a stronger signal than a shallow price cut. The strength of the signal is connected to the benefits coming from it (Deb, 2013).

However, the strength of the signal, as well as how effective it will ultimately be, also depends on the signaling environment. Like sound waves traveling differently in different mediums due to factors such as density, obstacles, or other interfering waves, the signal is impacted by the environment and its properties. The signaling environment greatly influences the signal's interpretations and outcomes (Connelly et al., 2011). While studies often disregard the signaling environment to limit the complexity, there have been attempts to account for it (e.g., Friske et al., 2023) by studying sustainability reporting as a signal. They considered temporal aspects to be the characteristics of the signaling environment that amplify the signal effect, as repetition over time should increase the strength of the signal (Friske et al., 2023).

## 2.4.2 Conceptual framework

Employing signaling theory, I wish to build the conceptual framework of this thesis, which explains the relationship between service innovation, service innovativeness, and consumer responses. The conceptual framework is presented in Figure 2. I present the logic behind it, considering three subsequent phases: signal, interpretation, and outcome.

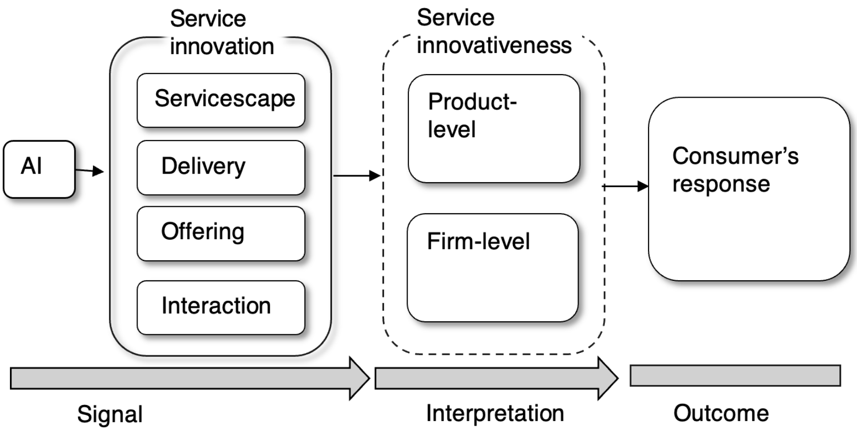


***Figure 2.*** *Conceptual framework of service innovations signaling service innovativeness*

The overall idea behind signaling theory, presented by Spence (1974) from a consumer perspective, is that "[one] reads the signal, interprets it in the light of past experience with its relationship to the quality which is unknown (…), and reacts accordingly" (p. 297). In marketing, it is common to consider the buyer and seller as signaler and receiver (e.g., Wells et al., 2011). A service provider who launches a service innovation can thus be seen as a signaler and the consumer of the service as a receiver. Service innovation is a signal of an unobservable service attribute (Rao et al., 1999), namely service innovativeness.

Service innovation is "a new process or offering that is put into practice (…) and creates value for [consumers] (…)" (Gustafsson et al., 2020, p. 112). Moreover, service innovation comprises changes in any of the dimensions of service innovation. The focus is on changes to service innovation dimensions, with a particular interest in changes enabled by AI. As I consider consumers' judgments, I focus on the changes above the line of visibility in the front stage of the service (e.g., Bitner et al., 2008; Shostack, 1984). Thus, service innovation may be seen as an observable signal (Cabaleiro-Cerviño & Burcharth, 2020).

In the interpretation phase, the consumer needs to process the signal and its meaning. Service innovation signals service innovativeness of both kinds. Firstly service innovation signals product-level service innovativeness ,consumer assessment of meaningfulness and novelty of service compared with alternatives (Mu et al., 2018; Zolfagharian & Paswan, 2009). By definition, product-level service innovation comprises changes that are new to the consumer and inherently linked with novelty (Truong 2013). By implementing service innovations, firms seek to better satisfy existing consumer needs or address new ones (O'Cass & Sok, 2013; Sok & O'Cass, 2015). Thus, service innovation serves as a signal of product-level service innovativeness due to the degree of novelty and meaningfulness it should comprise. However, consumers interpret the signal (service innovation) to judge not only the actual service but also the firm. Firm-level service innovativeness is a consumer view of a firm's capability to launch service innovations (Dotzel et al., 2013). Thus, intrinsic firm-level service innovativeness can be seen as a driver of service innovation. Yet, the firm can show this innovative capability by launching a service innovation. According to Kunz et al. (2011), firms that introduce service innovations are viewed by consumers as innovative; in other words, firm-level service innovativeness is perceived by consumers based on actual changes introduced to service innovation dimensions (Kurtmollaiev et al., 2022). As firm-level service innovativeness is unobservable, it can be judged only through observable cues, such as service innovations.

Finally, consumers should respond according to their interpretation of the signal. Assuming that they interpreted the signal in line with the intentions of the firm that introduced service innovations, the response should be positive and beneficial for the firm (Schuhmacher et al., 2018; Wells et al., 2011). However, since the interpretation of the signal may differ between consumers, the outcome of signaling can differ as well (Taj, 2016). Not only may the signal be misinterpreted but its effect can also be influenced by noise and the characteristics of the signaling environment (Connelly et al., 2011). Furthermore, as Connelly et al. (2011) and Kirmani and Rao (2000) note, ambiguous signals such as innovation, which lack a single universal meaning, can lead consumers to generate diverse or even opposing interpretations. Originally, signaling theory (e.g., Spence, 1973) assumes a rather uniform interpretation of a signal, yet interdisciplinary work borrowing from cognitive psychology and behavioral decision-making accounts for those subtleties (Connelly et al., 2011; Kirmani & Rao, 2000).

With consumers as receivers in the context of innovation, there are potential differences between individuals in terms of openness to change or personal innovativeness (Hirschman, 1980; Im et al., 2003). Similarly, Kirmani and Rao (2000) distinguished between how price-sensitive customers are when considering the effectiveness of a signal. Indeed, even if the interpretation of the signal is done as intended by the company, there may be other contradictory interpretations of the same signal or other cues acting as competing signals. For example, consumers may see an innovation as a signal of service innovativeness but also as a signal of high risk and then decide on which interpretation to act. Darke and Dahl (2003), for instance, consider that a discount may be seen positively as a good deal or negatively as being of inferior quality. Thus, negative outcomes of signaling are, in most cases, not intentional, yet they happen (Connelly et al., 2011).

# 3. Methodology

## 3.1 Philosophical foundations

Positivism used to be the dominant philosophy in marketing research (Arndt, 1985; Hunt, 1991; Thompson et al., 1989). In fact, marketing was one of the social sciences most loyal to positivism (Kiel, 1998). Positivism assumes objective, measurable reality investigated through scientific methods aiming at generalizable laws, yet, in consumer research, this philosophy is less strict than in physics or mathematics, as it allows for measuring aspects that are latent and uses subjective self-reported measures (Arndt, 1985; Hunt, 1991). However, positivism has been heavily criticized, which has led to the development of many alternative philosophical paradigms (Hunt, 1991; Thompson et al., 1989). Post-positivism is the philosophy that can be seen as the most immediate answer to the discussion around positivism. Post-positivism is also the philosophy reflected in this dissertation. Guba and Lincoln (1994, p. 109) state that post-positivism "represents efforts of the past few decades to respond in a limited way (that is, while remaining within essentially the same set of basic beliefs) to the most problematic criticisms of positivism." Post-positivism builds on positivistic ontology while assuming an epistemology that addresses the criticism of positivistic empiricism by acknowledging the subjectivity and probabilistic nature of knowledge and opening up to qualitative methods. In other words, post-positivism is characterized by ontological realism, yet this realism is not as naive as in the case of positivism but rather is more critical, as it assumes that reality exists independently of the observer but cannot be perfectly apprehended (Guba & Lincoln, 1994). In contrast to positivism, post-positivism is characterized by an epistemology that is not purely objectivist. While one strives for objectivity, knowledge is conjectural and can never be perfect (Fischer, 1998; Guba & Lincoln, 1994). With consumers and context varying, the findings are never universally true, so one needs to account for these differences. Due to the tentative nature of knowledge, it is subject to revision.

Philosophical foundations are visible in the main concept of interest of this dissertation and its chosen methodologies. I consider service to be an intangible output of a firm's activities or an immaterial offering (Lovelock & Gummesson, 2004). Vargo and Lush (2008) refer to such an approach as conventional logic. Thus, I consider both service and service innovations to be real. However, one can only measure it through the eyes of consumers whose views are affected by their experiences and personalities. Since I consider concepts from a consumer's point of view, I am accounting for the differences between people and potential biases, and so I am acknowledging that the obtained data gives me only an imperfect yet close approximation, not an objective reality. There are real cues that allow consumers to make a judgment of the service innovativeness. Service innovation is a real cue, while the key judgment I consider is service innovativeness.

## 3.2 Research design, data collection, and analysis

From the beginning, my doctoral studies aimed to develop research in the area of service innovation. Upon starting, I joined an ongoing literature review led by Aku Valtakoski, which clarifies the conceptual confusion surrounding different kinds of innovativeness and provides an integrative framework combining them. One of these concepts is service innovativeness, which has been found to be under-researched. While this initial study was still in progress, a second study began. It is an empirical study based on quantitative data from the SII concerning service innovativeness. This study broadly addresses the area of service innovation. As both of my supervisors were involved with the work on the SII, I was granted access to the empirical data used in Study II. Only while conducting this study did the aim of the thesis become more clearly defined. Thus, the first two studies were used to explore the area and build a deeper understanding of the field. Building on these insights, subsequent studies shifted toward a more targeted investigation of service innovativeness in the context of AI. In total, I conducted four main studies, summarized in Table 4, which informed five appended papers—with Study II contributing to both Papers 2 and 3.

***Table 4.*** *Studies' methodological details*

| ***Study*** | ***Design*** | ***Data collection*** | ***Sample*** | ***Analysis*** | ***Paper*** |
|---|---|---|---|---|---|
| *I* | Literature review | ISI Web of Science search and references check | 703 articles | Content analysis and coding | Paper 1 |
| *II* | Correlational study | Data are the part of Swedish Innovation Index survey | 5655 consumers | PLS structural equation modeling | Papers 2 and 3 |
| *III* | Correlational sub-studies | Online survey<br>Online survey<br>Physical observational study with survey | 245 consumers<br>300 consumers<br>77 consumers | Regression analysis (PROCESS) | Paper 4 |
| *IV* | Correlational study | Data scraping | 12,661 services | Topic modeling, coding, and multivariate analysis | Paper 5 |

Each study influences the next either methodologically or conceptually, as presented in Figure 3. First, the literature review (Study I) revealed the dearth of research and lack of clarity around service innovativeness, prompting an exploratory empirical approach in Study II, which focused on firm-level service innovativeness and identified key dimensions of service innovation. These dimensions guided Study III, which examined the interaction dimension using a service robot to explore product-level service innovativeness to account for various conceptualizations of service innovativeness. However, the robot's physical embodiment risked overshadowing the characteristics of virtual AI. To address this, Study IV includes virtual AI-enabled services, allowing for a broader understanding of AI's role in service innovativeness across both embodied and intangible forms.

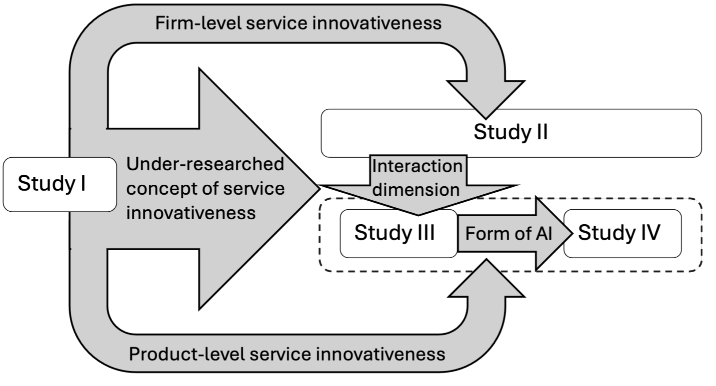


***Figure 3.*** *Research process*

The studies use different research methods and sources of data to obtain a more comprehensive understanding of the studied relationships. The literature review allows me to position my research and build on existing knowledge. It also serves as a possible way of generalizing the findings of further empirical studies by comparing them to those from different contexts and approaches. Such an approach allows for limiting potential biases, as one study design can address the limitations of another. Thus, while surveys are a beneficial way to obtain precisely the answers one desires, they limit the number of observations. These limitations can be addressed by data scraping, but there is no control over the data that are accessible. The use of various data sources allows for cross-validation and should lead to more robust findings (Bell et al., 2022; Johnson, 1997).

This dissertation strives to go beyond summarizing the four studies by integrating them using a conceptual framework that aims to explain the relationships among service innovation, service innovativeness, and consumer responses. This conceptual work follows the methodological approach explained by Jaakkola (2020) for the model kind of conceptual development and may resemble conceptual induction (Meredith, 1993). To arrive at the conceptual framework, one first needs to consider methodological requirements. In this very case, I was aware of what focal constructs I addressed, but the literature was lacking in the mechanism explaining their relationships. Thus, the choice of theory was dictated by its suitability to explain the relationship , in other words, by what can be called theories' supplementary value (Jaakkola, 2020). Signaling theory was chosen as one that had a high supplementary value in comparison to other possible theories. As for the role of various theories and concepts, one should distinguish between domain and method theories (Jaakkola, 2020). In this case, the service innovation field corresponds to domain theory or simply an area of study (MacInnis, 2011). However, signaling theory is purely a method theory, as it explains the relationships among constructs in the model (Jaakkola, 2020). Thus, to construct a framework, I used signaling theory and deductive reasoning to explain the links between the focal concepts (MacInnis, 2011).

### 3.2.1 Study I

The first study in this dissertation is a literature review. Its purpose was to establish a foundation for understanding the main concepts of the thesis, their interrelationships, and the broader concept of innovativeness.

We adopted an integrative review approach, as we aspired to go beyond summarizing the empirical research and to assess it critically (Elsbach & von Knippenberg, 2018). This method aligns well with the objective of clarifying the concept of innovativeness by exploring the diverse ways in which it has been conceptualized and examining how these conceptualizations relate to one another (Post et al., 2020). It was complemented by a manual in-depth content analysis of articles (D. Fan et al., 2022).

We adhered to Hiebl's (2021) guidelines during the article screening and selection process. First, we searched using the ISI Web of Science citation database, as it provides a comprehensive collection of major journals and has been widely used in prior reviews (e.g., Crossan & Apaydin, 2010; Raff et al., 2020). We searched for the term "innovativeness" in the title, abstract, or keywords. We included only journals ranked 3 and 4 on the AJG list and at least one citation to ensure the high quality and relevance of the publications used. To avoid omitting important papers, we also included publications that were used by at least six of the initially selected papers. Finally, we manually checked the papers to ensure that innovativeness is not used only tangentially but is an important aspect studied in a publication. After applying all these processes, we obtained 841 articles published between 1971 and 2022 for in-depth analysis.

These articles were divided between two authors and coded based on the codebook developed by the authors from a small sample of chosen articles. Three categories describing innovativeness were used for coding: a theoretical perspective, entity, and evaluation perspective. A theoretical perspective can be creative or adoptive. The creative perspective is aligned with the Schumpeterian view of innovation (Schumpeter, 1934), which focuses on the output of innovation process. On the other hand, the adoptive perspective draws on E. M. Rogers' (1962) innovation adoption curve and focuses on the willingness and ability to adopt innovations. Entity refers to whether innovativeness is considered a quality of the artifact or the actor. Finally, the evaluative perspective refers to who assesses innovativeness and can be perceived when judged by an external agent or intrinsic when an insider assesses innovativeness. Additionally, we noted the nomological position of the concepts by distinguishing among consequence, antecedent, moderator, and mediator. An analysis of the literature allowed us to create an integrative framework linking various types of innovativeness.

### 3.2.2 Study II

The second is a quantitative study using data from the SII for the year 2020. The SII assigns scores to firms and organizations from various service sectors in Sweden, based on their innovative ability, as assessed by their consumers (Fridberg, 2024). The index is based on thousands of responses gathered from consumers to gain the consumer's view on the firm's performance concerning service innovations and the firm's attractiveness. The SII survey is conducted regularly in an online form and measures firm-level service innovativeness, relative attractiveness, and four dimensions of service innovation: delivery, interaction, product, and servicescape. The survey was administered by a market research firm (we did not participate in the data collection) and gathered data about 28 different retailers, including H&M, Zara, and Lyko. Thus, the SII provides a benchmark for companies and industries, even at the level of innovation dimensions.

This study was used in Papers 2 and 3. In Paper 2, we considered the simple SII model, which considers service innovation dimensions, service innovativeness, and relative attractiveness.

However, we also calculated the index values for different sectors beyond retail. This allowed us to observe the differences and possible reasons why some sectors, such as online services, scored much higher on service innovativeness than others, such as the energy sector.

In Paper 3, we primarily focused on retail firms. In addition to the SII model, we considered imposed service innovations. Thus, for the year 2020, we added questions regarding consumers' views of innovations introduced due to the COVID-19 pandemic, which represented imposed service innovation. For the imposed service innovation, the scale was developed by us based on the changes retailers introduced during the pandemic. We validated this scale using factor analysis on the independent dataset and obtained significant factor loading for all items as well as high validity and reliability results for the scale (Afthanorhan & Afthanorhan, 2013; Ahmad & Afthanorhan, 2014; Hair, 2017). The items, as well as the validity and reliability measures for all variables, can be found in Paper 3.

Due to the exploratory nature of this study and the characteristics of the gathered data, the analysis of the data was conducted using partial least squares (PLS) structural equation modeling rather than covariance-based (CB) structural equation modeling (Chin & Marcoulides, 1998; Hair et al., 2011) with the software SmartPLS3 (Ringle et al., 2015). It is the same methodological approach used by the creators of the SII and Norwegian Innovation Index (NII) (Kurtmollaiev et al., 2023). We analyzed the model on three datasets, which we obtained by grouping the companies based on their characteristics in light of the COVID-19 crisis. Thus, in Paper 3, we considered online retail, grocery, and other retail stores, while in Paper 2, we distinguished only between online and physical stores. The scales used in the study, except for imposed service innovations, were validated by SII surveys from previous years and the NII (Lervik-Olson et al., 2017). Scales were adopted from the literature; for example, relative attractiveness was operationalized based on Andreassen and Lervik (1999) with four items, such as "To what extent is [firm X] more attractive than other similar companies," or service innovativeness borrowed from Kunz et al. (2011) with items such as "To what extent do you agree that [firm X] is a pioneer in its industry?" The full list of items for each construct can be found in the appendix of Paper 3.

### 3.2.3 Study III

Study III investigates how the social presence of the robot implemented in a service setting is connected with service innovativeness and satisfaction while considering the moderating role of robot anthropomorphism and customer innovativeness. Unlike other studies, this one was not exploratory but focused on testing six theory-driven hypotheses.

This study consists of three sub-studies, including two online vignette studies using Qualtrix and CloudResearch panels for data collection. The last was a field study performed in person with consumers at the store asked to answer the survey after a short interaction with a robot. The Furhat robot (see Figure 4) was the object of all sub-studies. It is a robot that has limited movement ability but is designed to have high social and conversational skills due to being powered by OpenAI.

***Figure 4.*** *Furhat robot used in Study III*

The first sub-study was a vignette study based on a video of the robot imitating a coffee shop employee. I focused on analyzing the relationships between three main constructs: social presence, service innovativeness, and satisfaction. The performed test considered that the relationship between social presence and satisfaction is mediated by service innovativeness. The second sub-study followed the same design; however, I added anthropomorphism as a moderator of the relationship between social presence and satisfaction and between social presence and service innovativeness.

Finally, the last study was a laboratory study in a retail store where participants needed to actually interact with the robot before answering the questions. There is a limited number of published studies using laboratory or field studies in which the customer experiences the interaction with the robot (exceptions are Holthöwer & van Doorn, 2022; Yam et al., 2021); thus, such a design was especially important to enrich the existing literature. A laboratory study provides a trade-off between realism and control of study settings, thus allowing for high internal and external validity (Lynch, 1999; Malodia et al., 2023), especially in cases like min, where the lab experiment was highly realistic and conducted in an actual retail store (Winer, 1999). Moreover, researchers can observe the participants' actual behaviors and their interactions with the robot. In this sub-study, I examine the model as in the first sub-study, incorporating moderation from customer innovativeness on the relationship between service innovativeness and satisfaction.

The items used in the study were borrowed from previous research. For example, satisfaction was measured with items taken from Söderlund (2016) such as "To what extent does this store meet your expectations?" The full list of items for each construct can be found in the appendix of Paper 4. To test the hypothesis in each of the sub-studies, we used the PROCESS macro in SPSS (Hayes, 2022), which allows for the analysis of more advanced regression models. Additionally, to deepen the primary analysis, I ran floodlight analysis (Spiller et al., 2013) using R, as it allows for a detailed understanding of moderation when a moderator is a continuous variable. The moderators (customer innovativeness and anthropomorphism) were continuous and measured on a scale of 1–7.

### 3.2.4 Study IV

The last study uses secondary data scraped from the website "There's AI for That," one of the biggest databases for AI-enabled services. The scraping was done using Octopase software (like Dhakate & Joshi, 2023) for data from the year 2015 until June 2024, when the study was conducted. Additionally, information on around 50 AI-enabled services was gathered manually when the software was unable to access the information. For each of the 12,661 AI-enabled services, we gathered information such as name, launch date, description, number of saves, and rating.

As a second step, we ran unsupervised topic modeling using BERTopic (as recommended by Sánchez-Franco and Rey-Moreno, 2022) on the descriptions of the AI-enabled services. Topic modeling is a technique in natural language processing that identifies topics in a collection of textual data. BERTopic, despite being a new approach to topic modeling, is considered a new standard due to its superiority in understanding the context of the analyzed data (Chiarello et al., 2024; González-Carvajal & Garrido-Merchán, 2021). As a result, we obtained 177 topics. Based on the Huang et al. (2019) classification of tasks representing mechanical, thinking, and feeling intelligence, we manually coded the topics considering the intelligence types that the AI-enabled services from the given topic exhibit.

We quantitatively described the data as well as the obtained topics. Later, we analyzed the differences between the satisfaction of consumers with AI-enabled services based on the type of AI, using ANOVA and controlling for the launching date. Next, a similar analysis was conducted to observe differences between the number of users of AI-enabled services based on the type of intelligence of those services. The quantitative analysis was done using SPSS software. As ANOVA is sensitive to outliers, we cleaned the data before the analysis.

## 3.3 Quality

Quality criteria differ between studies, as I used various methodologies. Thus, the quality of the studies is discussed in the papers that cover the given study. In this section, I focus on the overall quality of the dissertation.

Three main business research quality criteria—reliability, validity, and replicability (Bell et al., 2022)—are used to discuss the quality of the research in this dissertation. This dissertation benefits from a multi-method approach (literature review, quantitative studies from consumer responses, and scraped and coded data). This methodological diversity enables triangulation, which strengthens the reliability of the findings (Swanborn, 1996). The consistency of the results across studies and samples further supports the reliability of the dissertation (Bell et al., 2022).

As I focus on both product-level and firm-level service innovativeness, the concept of service innovativeness varies across papers, which also implies differences in operationalizations. It is important to stress that these differences are discussed throughout the dissertation. If not carefully distinguished, the use of varying operationalizations arising from the different natures of the two types of service innovativeness raises validity concerns, as it could lead to false conclusions. This is not a concern here, as I clearly distinguish the two concepts in the theoretical part as well as the findings and discussion, highlighting their differences and similarities. A clear distinction among concepts sharing a common name also enhances construct clarity, which is not only crucial for knowledge building but can itself be seen as a contribution (Suddaby, 2010).

Here, I discuss internal, external, and ecological validity, as measurement validity is covered in the individual papers. Triangulation in the form of methods and data, which increases reliability, also bolsters the internal validity of the dissertation (Bell et al., 2022; Johnson, 1997). Most of the studies (Studies I, II, and III) in the dissertation employ surveys to gather data, which allowed me to control the content of the questionnaire and scales, which potentially adds internal validity. However, I also use secondary data (Study IV) from consumer behavior on a website, which not only allows for unbiased data but also sets the study in a real-life context. Such sourcing of the data further enhances the external and ecological validity of the dissertation (Bell et al., 2022). External validity also benefits from a variation of contexts (Bell et al., 2022; Swanborn, 1996), which can be observed between different studies of this dissertation, or sometimes within a single study (retail, hospitality, virtual services, etc.). A possible drawback may be that I capture changes in the service innovation dimension in different ways between studies, which may negatively affect validity. For instance, in Study II, the change in the service innovation dimensions is captured by asking for it precisely and distinguishing between various dimensions; however, in Study V, we consider the higher type of intelligence of AI used in services to be a greater degree of aggregated change in all dimensions without distinguishing between them. A detailed discussion of how the changes in service innovation dimensions are captured is presented in the Findings section.

Finally, this dissertation addresses replicability through the applied research methods and transparency. I use predominantly quantitative research, which values objective analysis and bias reduction (Lim, 2024), and thus enhances the potential for replication (Bell et al., 2022). The use of secondary data from publicly available databases or literature in some of the studies further supports replicability. However, given the rapidly evolving nature of AI and its societal impact, future replications on new datasets may yield different results—particularly as consumer adoption progresses (Nosek et al., 2022). This dynamic context, while creating challenges, also underscores the timeliness and relevance of the research.

## 3.4 Ethics

Ethics in the social sciences focuses on the following aspects: harm to participants, a lack of informed consent, invasion of privacy, and deception (Diener & Crandall, 1978). To ensure participants' safety and protect their privacy, all studies involving human participants were conducted anonymously. Participation was voluntary, and consumers could withdraw at any time without providing a reason. When collecting the data, consumers were introduced to the studies to be able to provide informed consent and asked to sign or approve the informed consent form (paper form or clause at the beginning of the online study) as advised to prove the ethical conduct of research (Bell et al., 2022). This also prevented possible deception and increased transparency in informing participants and handling the studies. Additionally, I did not collect any sensitive information or data that would allow for tracing back to the individual respondents to ensure privacy and safety for the respondents.

Real-life studies with the use of the robot can raise some ethical concerns, owing to the fact that the robot analyzes the video it obtains through the camera to be able to behave in a socially responsive way. Understanding the spoken answers was only possible by decoding the voice input. However, neither the video input nor the audio was stored by the robot to minimize potential ethical concerns connected with the avoidance of harm and privacy of respondents. Robots are still a novelty for many consumers; thus, they may feel threatened by some of their behaviors. Therefore, although the consumers interacted with the robots without the researcher's presence to avoid bias, the researchers continuously observed the interactions and were ready to intervene if the consumers felt uneasy. Moreover, technology can sometimes be unpredictable; thus, researchers had wireless access to the robot through the computer and were able to interfere with its behavior and what it says immediately in case the robot behaves differently from the way expected. This prevented any potential harm to the participants.

In the case of scraped data, there are some ethical and legal aspects that need to be considered, such as following the source's terms and conditions or not scraping private or protected information; therefore, this method is often controversial. However, it alone often offers the possibility of obtaining certain data. To ethically and respectfully scrape the data, I followed Boegershausen et al.'s (2022) recommendations and gathered only information that was publicly available, thus not invading the privacy of any person. The data are only used for research purposes and were aggregated on the AI-enabled service level, not the customer level, thus not causing any potential harm to individuals or their privacy.

# 4. Summary of findings

This chapter gives an overview of papers appended to the doctoral dissertation, with emphasis on summarizing the findings, which will guide future discussions and help answer the research questions.

## 4.1 Paper 1—Unpacking innovativeness: A typology and integrative framework for innovation research

**Authors:** Aku Valtakoski, Joanna Pilawa, and Lars Witell

**Status:** Working paper

**Contributions:** Article screening**,** coding a substantial part of articles (over 400), codeveloping coding criteria, reviewing the manuscript, providing feedback and changes, and navigating reviewers' comments.

**Overview of the paper:**
This paper seeks to clarify how innovativeness concepts are conceptualized and applied in innovation research to enhance their theoretical coherence and practical relevance. Using a systematic review of extant research that employs diverse innovativeness concepts (Cronin & George 2023; Elsbach & van Knippenberg 2020), we address the following research questions: "(1) What distinct types of innovativeness have been used in the literature? (2) Which key characteristics help distinguish between the identified innovativeness constructs? (3) How are the different innovativeness constructs interrelated? (4) What gaps exist in the extant literature on innovativeness?"

In this paper, we present a typology that consists of seven distinct types of innovativeness, differentiating between creative and adoptive innovativeness, as well as intrinsic and perceived innovativeness. Using the proposed typology, we created an integrative framework, as seen in Figure 5, which links together those various types of innovativeness throughout the innovation lifecycle. Here I primarily discuss the findings connected with service innovativeness, which adds the most to this dissertation. In the framework, I marked the service innovativeness constructs blue. We did not explicitly name any of the types as service innovativeness; rather, we considered product innovativeness when considering any artifact—products, services, and portfolios—as a product. I use the term service innovativeness to discuss the findings connected with it. We also found that despite organizational innovativeness and service or product innovativeness being distinct, considering their epistemology and ontology, some studies treat the latter as a firm-level concept describing the organization's overall innovativeness. An example of service innovativeness treated as a firm-level concept is McLeay et al. (2021). This is why we can also consider organizational innovativeness as firm-level service innovativeness. In the dissertation, we mainly consider the perception of those concepts; thus, the variables of interest in the paper are perceived product innovativeness and perceived organizational innovativeness, which in this dissertation are partially reflected in product-level and firm-level service innovativeness.

Through this review, we observed the rise of studies covering perceived innovativeness, which seems to be linked with the growth of research on the innovativeness of intangible offerings, such as service innovativeness, as their evaluation is harder than that of physical goods innovativeness (cf. Stock, 2011).

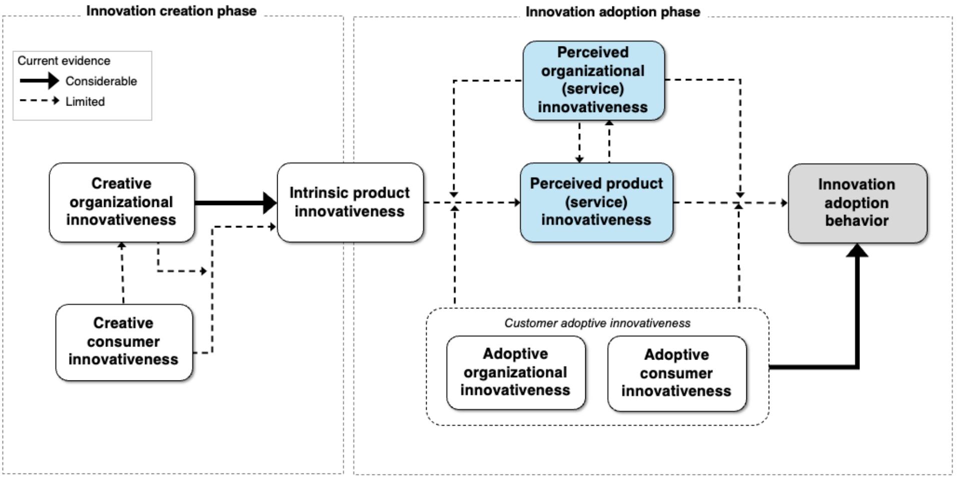


***Figure 5.*** *Simplified integrative framework from Paper1*

The majority of research on product (services and physical goods) innovativeness considers it an intrinsic concept, meaning seen from a firm perspective. This is problematic once we consider how appropriate a firm's assessment of innovativeness is for innovation adoption since intrinsic conceptualizations disregard the perception of actors adopting innovation. It is likely that the discrepancy between intrinsic and perceived product innovativeness is greater for service innovativeness than for tangible product innovativeness (Dotzel, Shankar, & Berry, 2013), given the importance of subjective experience for many service-based offerings (Ostrom et al., 2021). Moreover, certain types of innovations are less visible to consumers, for example, process innovations that happen below the line of visibility. This further enlarges the possible discrepancy between consumer and firm perspectives.

The framework also indicates a bidirectional link between firm-level and product-level service innovativeness. While none of the studied papers proposed a bidirectional link, they proposed various directions for this link and proved them empirically. Both innovativeness concepts concern consumers' perceptions, thus it is especially plausible in services for such a bidirectional link to exist, especially since consumers have difficulties differentiating between the service and the provider (Iacobucci et al., 1995).

Finally, product-level service innovativeness was found to be connected to consumer responses such as adoption. However, firm-level service innovativeness did not directly lead to such results but rather acted as a moderator of the relationship between product-level service innovativeness and adoption.

## 4.2 Paper 2—Service innovation in the eyes of customers: The Swedish Innovation Index

**Authors:** Joanna Pilawa, Lars Witell, and Per Kristensson

**Status:** Published in the book *Service Innovation and Management: Digitalization, Service Infusion and Customer Experience*

**Contributions:** Writing 70% of the manuscript.
The empirical data for this study were part of the Swedish Innovation Index project, and they were not gathered primarily for this study.

**Overview of the paper:**
This work aims to discuss service innovation and the importance of considering service innovativeness from the consumer side. We consider firm-level service innovativeness in this

work. Traditionally, the firm view is taken on innovation and, consequently, innovativeness in research; however, there is a growing trend to apply the customer view. Each of these perspectives has drawbacks and benefits; the paper advocates applying the consumer’s lens in line with Kurtmollaiev et al. (2022). While consumers often do not possess the technical knowledge required to assess innovation and cannot confront changes in a firm’s capabilities, they are the end users and adopters; thus, their experience will greatly influence the success of a given service innovation and a firm.

One way of capturing consumers’ judgments on innovations is by considering the outcomes of SII. This measure was based on the NII, which rests on two central assumptions: firms are innovative, and the consumer is the final judge. SII follows the model, which considers how four different dimensions of service innovation impact service innovativeness and subsequently influence attractiveness. The dimensions considered are interaction space, value proposition, value actualization, and relationship experience (Lervik-Olson et al., 2017). These dimensions, despite different names are equivalent to the dimensions proposed in section 2.1.2.

The SII allows for finding the most innovative firms and sectors, as well as firms that improved or declined the most, due to its being issued every year. Our findings show that although IKEA and Spotify demonstrate high levels of service innovativeness, their respective sectors do not. In 2022, online services was indeed the sector with the highest service innovativeness; retail, however, came as third. Surprisingly, banking was second to the last, and energy came last.

The dimensions of service innovations that are the most important differ between sectors; however, the general insight is that value proposition and interaction space usually produce the best results if the firm wishes to be seen as innovative.

The SII allows for identifying leaders for each industry, as well as benchmarking between firms and industries. Because it is conducted regularly, it offers a longitudinal perspective, which makes it a valuable tool for tracking trends and guiding strategic decisions.

This paper can be seen as a stepping stone for the subsequent one, which focused on considering the SII model more empirically while expanding it to account for the context of the pandemic.

## 4.3 Paper 3—Service innovativeness in retailing: Increasing relative attractiveness during the COVID-19 pandemic

**Authors:** Joanna Pilawa, Lars Witell, Aku Valtakoski, and Per Kristensson

**Status:** Published in the *Journal of Retailing and Consumer Services*

**Contributions:** Data analysis, writing 50% of the original manuscript, adjusting the paper together with other authors based on feedback from the reviewer, and writing part of the response letter to reviewers.

The empirical data for this study were part of the Swedish Innovation Index project, and they were not gathered primarily for this study.

**Overview of the paper:**

This work focused on the role of service innovativeness in retailing firms during the COVID-19 pandemic. In this paper, we follow firm-level service innovativeness. Specifically, the paper investigates "(a) how different service innovation dimensions—offering, delivery, interaction, servicescape—influence service innovativeness and (b) whether COVID-imposed innovations mediate the relationship between service innovativeness and relative attractiveness." Figure 6 represents the framework used to explore the relationships between constructs.

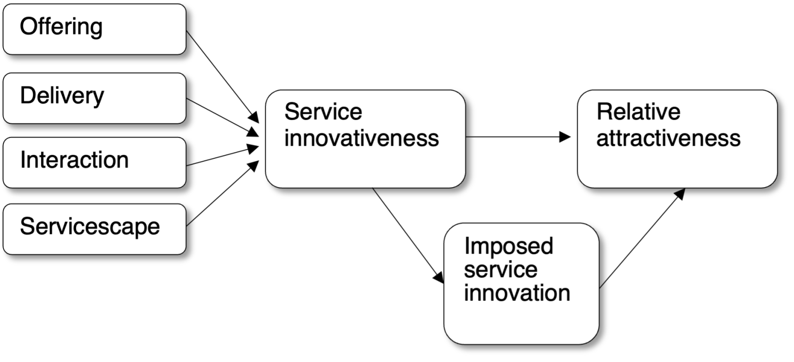


***Figure 6.*** *Framework presenting the relationships studied in Paper 3*

We analyzed three subgroups of retailers: online retail, grocery, and other retail. The key dimensions driving service innovativeness differ depending on the subsector. We found that changes in the servicescape and service offering are key dimensions that influence service innovativeness in physical retail (grocery and other retail). For the grocery subsector, delivery had no significant effect on service innovativeness. However, for e-retailers, changes in those dimensions were not equally important. Changes in delivery do not impact service innovativeness for online retailers but the change in offering is key. Considering the differences between subsectors, there is a need for emphasis on various service innovation dimensions tailored to different retailers, and to note that physical retailers need to be cautious while developing a virtual servicescape. These findings contribute to understanding how consumers view and value service innovations.

In all retail subsectors, service innovativeness considerably affected relative attractiveness and imposed innovations. This suggests that irrespective of retailer type, being innovative is positively related to the attractiveness of the retailer to consumers in comparison with its competitors. In crisis situations such as the COVID-19 pandemic, service innovativeness allows retailers to adapt to circumstances and stay attractive. The service innovativeness also significantly affects the imposed service innovation.

The results suggest a partial complementary mediation effect of service innovativeness on relative attractiveness in the grocery and other retail sectors. We also examined the mediation effect within the online retail sample as a boundary condition but found no mediation effect of imposed service. It was anticipated that, unlike physical retailers (grocery and other retail), online retailers were not compelled to adjust their business models by the COVID-19 pandemic. Findings on COVID-imposed service innovations stress the crucial role of service innovativeness in successfully adjusting to restrictions and consumers' safety needs. Moreover, the findings indicate the importance of context and staying up-to-date with service innovations.

This research presents how beneficial service innovativeness is for overcoming crises and in endeavors to improve the relative attractiveness of the firm on the market. Most importantly, corresponding to the aim of this thesis and research questions, the study demonstrates the role that different service innovation dimensions play in forming service innovativeness in consumers' minds and indicates the positive relationship between service innovativeness and relative attractiveness.

## 4.4 Paper 4—“So you got the brain but have you got the touch?”: The impact of the social presence of service robots and service innovativeness on customer satisfaction

**Author:** Joanna Pilawa

**Status:** Working paper

**Contributions:** Study design, data gathering (with the help of Amie Gustafson and Jasenko Arsenovic), data analysis, and manuscript writing

**Overview of the paper:**
This article aims to address calls for further research into the impact of robots on consumers (Lu et al., 2020) and the advancement of service delivery through technology (Hollebeek et al., 2019). Specifically, we focus on changes within the interaction dimension of service innovation. By introducing a service robot as an interactive partner, we aim to examine how its social presence affects customer satisfaction during service. Further, we investigate the role of product-level service innovativeness in relation to the social presence of service robots and customer satisfaction with service encounters. To deepen our understanding of these dynamics, we also investigated how key contextual factors—such as robot anthropomorphism and customer innovativeness—moderate these relationships. In this article, service innovativeness is conceptualized at the product level.

The framework presents the relationships that were hypothesized and subsequently tested. The findings demonstrate that social presence is paramount in a service encounter. The social presence of the robot was found to positively affect satisfaction, especially when the anthropomorphism of the robot is low. We also discovered that social presence is positively connected to service innovativeness; thus, it drives consumers’ perspectives on services. Service innovativeness has a positive influence on satisfaction, even more so for innovative consumers. These findings indicate the existence of a partial mediation effect of the relationship between social presence and satisfaction through service innovativeness. This mediation effect is especially important when the robot is highly anthropomorphic, as then there is no direct effect of social presence on satisfaction. However, anthropomorphism does not moderate the relationship between social presence and service innovativeness despite being hypothesized to do so. Thus, in Figure 7, the arrow representing this relationship is a dashed and not a solid line.

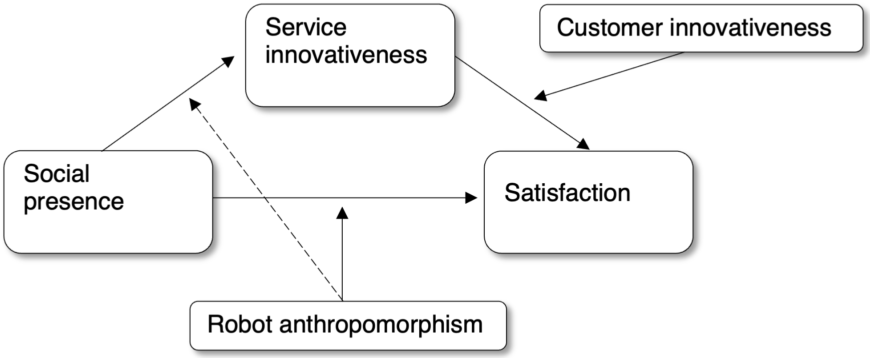


***Figure** 7. Framework presenting relationships studied in Paper 4*

Considering the findings of this study from the perspective of the aim and research question of this dissertation, we focus on a few aspects. The findings suggest that service innovation is linked to product-level service innovativeness. Moreover, we see that the higher the social presence, the higher the service innovativeness. Product-level service innovativeness is found to lead to consumer outcome, namely satisfaction.

## 4.5 Paper 5—Quo vadis AI?: Exploring users' responses to and use of AI-enabled services

**Authors:** Joanna Pilawa, Melvin Rohn, and Kristina Heinonen

**Status:** Working paper

**Contributions:** Data gathering and analysis, coding (together with coauthors), writing about 50% of the manuscript

**Overview of the paper:**

As AI increasingly drives service innovation (Rust & Huang, 2014; Ostrom et al., 2021), with AI being recognized as a key driver (Rust & Huang, 2014), and gains prominence as a research priority (Ostrom et al., 2021), researchers are striving to advance understanding of its role in services. Most research on AI in services tends to concentrate on specific applications within particular industries, such as banking or financial investment, providing valuable yet limited insights (Flavián et al., 2021). However, a more comprehensive understanding of AI's impact requires examining how consumers select, interact with, and respond to AI-enabled services across a wider range of contexts. We aim to investigate the use cases of AI across different types of AI. Furthermore, we explore how varying AI types in services influence customer preferences and engagement to uncover what drives customers' usage of AI.

In the paper, we follow the most prevalent classification of AI intelligence proposed by Huang and Rust (2021). Thus, we distinguish mechanical, thinking, and feeling AI, where feeling is the most advanced and mechanical is the most basic one (Huang & Rust, 2021). The higher the type of intelligence, the more advanced the tasks the service can handle. Thus, from the perspective of the thesis, the higher AI type can be seen as higher product-level service innovativeness.

This paper suggests that despite the exponential growth of the market of AI-enabled innovations, most of the services represent thinking intelligence and are thus not focused on solving very advanced tasks. At the same time, consumers were found to be more eager to adopt AI-enabled services with lower AI instead of higher ones. However, they are more satisfied with services that represent higher types, as presented in Figure 8. This finding is especially interesting and important from the perspective of this dissertation. The contradictory tendencies for adoption and satisfaction between different types of intelligence indicate two consumer responses: one positive (bigger satisfaction) and one negative (lower adoption).

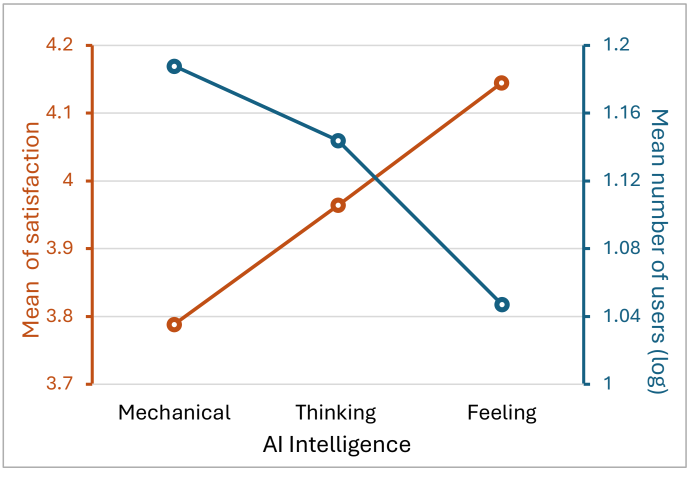


***Figure 8***. *Satisfaction and number of users per AI type*

# 5. Discussion

This dissertation strives to enhance the understanding of consumer view on service innovativeness through the lens of signaling theory. Based on the findings of the included papers, the framework from section 2.4.2 was updated, as shown in Figure 9. The main changes to the conceptual framework concern consumer responses and the relationships between different service innovativeness types. The findings suggest that different service innovation dimensions have various importance in signaling service innovativeness, yet they can signal both product-level innovativeness and firm-level innovativeness. The results also indicated a possible bidirectional relationship between product-level service innovativeness and firm-level service innovativeness; thus, this relationship was also included in the conceptual framework. In line with signaling theory, I found that consumers respond to the signal, regardless of whether they interpret it as a signal of product-level service innovativeness or firm-level service innovativeness. Yet, the responses differ; indeed, the signaling can lead to both positive and negative consumer responses, and this is the case in my studies. Consumer responses became more precisely defined in the conceptual framework to include those studied in the appended papers: adoption, satisfaction, and relative attractiveness. Since adoption shows different trends between studies, the conceptual framework includes both negative and positive relationships. This conceptual framework is used to guide the following discussion.

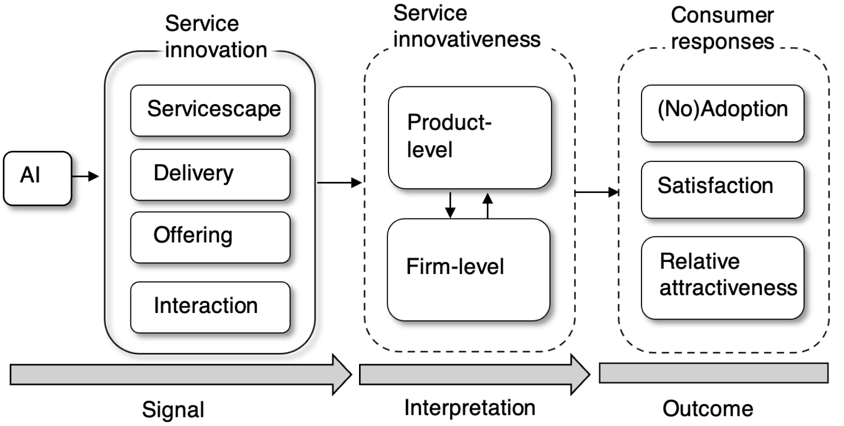


***Figure 9.*** *Revised conceptual framework*

## 5.1 Service innovation as a signal

It is uncommon to use service innovation as a signal. One of the few examples of using signaling theory in the service innovation context is Stock (2011), claiming that service innovativeness is a signal of a company's ability to meet consumers' expectations. Unlike Stock (2011), I do not consider innovativeness to be a signal. The signal should be easy to observe and interpret in a way that reveals an otherwise unobservable quality (Connelly et al., 2011). Therefore, I position service innovation as the signal, with service innovativeness being the quality it conveys. Thus, the closest to my argument is the argument of Hoang et al. (2025) that robots may signal brand innovativeness. They state that robots are "sophisticated technological innovations" (p. 18) and thus signal brand innovativeness. In contrast to Hoang et al. (2025), I study service innovativeness rather than brand innovativeness, yet their example of introducing a service robot is a form of service innovation that I also consider.

All empirical papers (Papers 2–5) feature different forms of service innovations. This dissertation studies how these service innovations are linked with service innovativeness. The results of the papers on the SII (Papers 2 and 3) suggest that service innovations are linked with firm-level service innovativeness. Similarly, Paper 4, on service robots, presents how service innovation affects product-level service innovativeness. Like Hoang et al. (2025), I found that service innovation signals service innovativeness, both at the firm and product levels. In other words, based on empirics, service innovation is an antecedent of service innovativeness at both the firm and product levels. Moreover, my findings suggest that companies can successfully use service innovation to signal innovativeness and that service innovation is an effective signal from a signaling theory (Spence, 1974) perspective.

### 5.1.1 Dimensions of service innovation and signal strength

In the empirical papers, service innovation was captured in slightly different ways. Service innovation is a change in the service innovation dimension that should bring benefits to consumers (Gustafsson et al., 2020), but the degree of change can differ. In the study on the SII, I directly measured a change in each service innovation dimension (Papers 2 and 3). In papers focused on AI (Papers 4 and 5), I captured the degree of positive change, which constitutes service innovation, differently. As Paper 4, which considers service robots, mainly focuses on the change in interaction dimension, I used the social presence of the robot to measure how consumers see the degree of change in this dimension. In Paper 5, which discusses various AI-enabled services, I did not differentiate between the dimensions but instead took the aggregated view of the degree of change. Thus, I used AI type to capture the degree of change in all service innovation dimensions. The more intelligent the AI is, the more complex and advanced the tasks it performs; thus, the degree of change can be associated with the type of intelligence.[1]

This degree of change determines the strength of the signal. Signal strength is one of the important signal qualities that can affect signaling dynamics (Prabhu & Stewart, 2001; Vanacker et al., 2020). Similarly to Spence (1974, 2002), where the higher level of education signals the higher productivity of the employee, I found that a greater degree of change in service innovation dimensions signals higher service innovativeness. Changes in different service innovation dimensions have a positive impact on firm-level service innovativeness (Papers 2 and 3). Paper 4, on service robots, additionally provides evidence that the greater the change in the service innovation dimension, the greater the product-level service innovativeness. The strength of the signal is linked to the signal's cost (Deb, 2013), which is a central characteristic of a signal (Connelly et al., 2011; Spence, 1974). Going back to Spence's (1974) example of education signaling productivity, the higher the education, the more expensive the tuition, and the more time one needs to invest in finishing the studies. In the case of service innovation, the greater the degree of change, the more investment is most probably required. For example, the more social presence the consumer senses from the robot, the more advanced and subsequently more costly the technology is. Thus, the findings are in line with the assumptions of signaling theory and suggest that the greater the degree of change in service innovation, the stronger the signal, leading to higher service innovativeness on both the product and firm levels. This further suggests that service innovation is a proper signal that can be used by companies to impact consumer judgment of service innovativeness, but above all, the findings show that this judgment can be influenced by adjusting the strength of the signal.

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[1] While the type of intelligence was not measured from a consumer perspective, it was also not an internal evaluation, rather researchers' judgment. That is still an outsider's opinion and looking at the relationships between innovativeness concepts from the perspective of the literature review (Paper 1), the intrinsic service innovativeness leads to the perception of service innovativeness; thus, the researchers assessment is used as its approximation.

### 5.1.2 Signaling environment of service innovation

Not all dimensions of service innovation signal service innovativeness equally well. Those differences in which dimensions convey a stronger signal also differ between industries (see Papers 2 and 3). Looking at this finding from the perspective of signaling theory, one can consider it to be the effect of the signaling environment. Although in most of the studies, I did not account for the signaling environment, I acknowledge that signaling does not always occur in a uniform environment. To account for this, scholars considered, for example, competitiveness both within the industry (L. Fan et al., 2021) and between industries as an aspect of the signaling environment that distorts the observability and interpretation of the signal (Lamin, 2013; Moradi et al., 2024). Like Fiske et al. (2023), who focused on sustainability reporting, I found that industry is an important aspect of the signaling environment that changes how observable and differently interpreted signals are. I found that for grocery and other physical retailers, changes in the servicescape and offering dimensions of service innovations were stronger signals than other dimensions (Paper 3). For online retail, only the offering dimension was able to succeed in conveying the signal (Paper 3).

Indeed, service characteristics make considerations of services unusually context dependent and challenging, considering the diversity of the contexts (Voss et al., 2016). The importance of context in service research is also visible in the differences in service innovativeness scores in different service sectors, as discussed in Paper 2. While online services are by far the most innovative, security services and retail are not far behind in terms of firm-level service innovativeness. At the same time, energy services score very low in firm-level service innovativeness. Even though IKEA is one of the most innovative firms, the retail sector is only third. Moreover, IKEA and Spotify, which are the top innovative firms in the SII, are greatly different, and so are the changes they are introducing to stay innovative. While I do not focus on the signaling environment in this dissertation, it is an important finding and potentially a path to explore in future research, considering both the perspectives of signaling theory and service research.

## 5.2 Interpretation phase—decoding signal into service innovativeness

After receiving the signal, the consumer needs to interpret it, hopefully in the way the sender intended, decoding it into service innovativeness. Both product- and firm-level service innovativeness can be an interpretation of the service innovation signal (see Papers 2, 3, and 4). One of the reasons why both conceptualizations seem to be a suitable interpretation of the signal is the interconnection between firm- and product-level innovativeness (Paper 1). Both conceptualizations of service innovativeness impact each other; thus, the relationship goes in both directions, as seen in the conceptual framework in Figure 8. While in the literature review on innovativeness (Paper 1), I considered not only services but also products, this relationship between firm- and product-level service innovativeness (in the paper called perceived organizational and perceived product innovativeness) seems to be even more relevant for services. These constructs present consumers' judgments, which are not objective measures of service innovativeness, and consumers tend to conflate judgment of service and the service firm (Iacobucci et al., 1995). It is challenging to separate those judgments due to the intangible and inseparable character of the service, as well as significance of physical evidence and employees in service delivery (Bitner, 1992).

The exact mechanism behind this bidirectional effect was not considered by any of the papers studied in my literature review. Rather, different studies suggested different directions (e.g., Barone & Jewell, 2013; Hubert et al., 2017; Shams et al., 2015). Some authors (Barone & Jewell, 2013; Hubert et al., 2017; Shams et al., 2015) explain the mechanism using information processing theories or schema theory. Indeed, in examining consumer judgment and perception, cognitive theories appear to provide a plausible explanation for the connections between different service innovativeness concepts. Firm-level service innovativeness can be seen as a mental shortcut or heuristic to judge product-level service innovativeness, basing the argumentation on schema theory (Fiske & Linville, 1980) or brand extension theory (Aaker & Keller, 1990). Yet, it seems as plausible to argue for the opposite, using, for example, schema theory, as done by Hubert et al. (2017). Then, a service that a company provides can become a representative of the company, so the product-level service innovativeness of that service will serve as a schema activated in the context of the given company. That train of thoughts leads to a chicken-or-egg dilemma. In most cases, product-level service innovativeness needs to exist first to have a spillover effect on firm-level service innovativeness, as firms are not recognizable if they do not offer anything to the consumer. Yet, while that may be the most common beginning of the cycle of mutual reinforcement between product-level and firm-level service innovativeness, it is not the only one. As observed by Barone and Jewell (2014), communication serves as a tool for shaping consumer views on innovativeness; thus, a firm may engage in proper marketing communication before launching any service to create an innovative image. Therefore, firm-level service innovativeness may be a starting point. Such a scenario, although not entirely impossible, is less plausible and harder to achieve. After determining the starting point of the bidirectional relationship between service innovativeness types, one can then consider how this cycle persists. Drawing from cognitive psychology, as done by the authors arguing for unidirectional links (Barone & Jewell, 2013; Hubert et al., 2017; Shams et al., 2015), can be valuable. Humans suffer from cognitive biases, such as the halo effect and confirmation bias. The halo effect (Dagger et al., 2013; Thorndike, 1920) is a tendency of a judgment of one area to impact the judgment of the other; thus, a positive assessment of one type of service innovativeness will impact the assessment of the other type. However, this effect can be sustained by confirmation bias (Lallement et al., 2020; Wason, 1960), which is a tendency to overlook evidence or information that is in opposition to one's beliefs and only notice what confirms their primary conviction. Thus, if one starts by believing that firm-level service innovativeness is high and transfers that belief to the product level (or vice versa), this person will overlook any possible evidence that it works otherwise, limiting the friction for the cycle of reinforcements.

## 5.3 Consumer responses as signaling outcomes

The link between the interpretation, meaning service innovativeness, and a signaling outcome, which here is in the form of consumer responses, was tested in nearly all the papers (Papers 1–4). I considered a few of the potential consumer responses that a firm may want to influence by signaling service innovativeness. Like other studies using signaling theory (e.g., Ni and Sun, 2017), I used satisfaction as a response to the signal. Additionally, I considered relative attractiveness and adoption as possible consumer responses.

Based on the SII papers (Papers 2 and 3), there is a positive link between firm-level service innovativeness and consumer response, notably relative attractiveness. However, the literature review (Paper 1) has not indicated this; thus, there is no direct relationship between firm-level innovativeness and any customer response marked in the integrative framework of Paper 1. This may be due to the different consumer responses being studied. In papers on the SII (2 and 3), I considered the relative attractiveness of the firm, while the literature review (Paper 1) studied adoption as a signaling outcome. Those signaling outcomes, while both positively connected to the interpretations, are on different levels, similarly to the type of service innovativeness that influenced those outcomes.

In the paper on AI-enabled services (Paper 5), I considered the direct effect of service innovation on consumer responses (satisfaction and adoption). However, in the study on service robots (Paper 4), I found partial mediation between service innovation and consumer response through innovativeness. Considering the findings from the paper on AI-enabled services (Paper 5) through the lens of mediation findings of the service robot paper (Paper 4), the part of the relationship between service innovation and satisfaction or adoption can be expected to be mediated through the signaled service innovativeness. Findings for AI-enabled services (Papers 4 and 5) are not in line with the general integrative framework from Paper 1. The literature review predicts a positive link between product-level service innovativeness and adoption (Paper 1). However, the study on AI-enabled services (Paper 5) finds that fewer consumers are adopting service innovation, with a higher degree of change in service innovation dimensions.

At the same time, findings from studies concerning AI (Paper 4 and partially Paper 5) indicated a positive effect of product-level service innovativeness on satisfaction. This is in line with Stock (2011) who also shows a positive relationship between product-level service innovativeness and satisfaction. It is intriguing that consumer responses have mixed valence and that satisfaction and adoption are in fact in opposition. The objective of the signal is a positive outcome, yet it may be negative as well, especially since the interpretation of the signal depends on the consumer who is the receiver, not the sender (Connelly et al., 2011; Su & Rao, 2010). Thus, it is necessary to consider different possible responses, as one positive response does not guarantee that the same signal is not also triggering a negative response. In such a case, one should take a closer look at the signaling dynamics. AI-enabled innovations seem not to always follow the same patterns as those discussed in previous literature; thus, they require further consideration.

## 5.4 AI-enabling service innovations

Rust and Huang (2014) claim that AI is currently the main source of innovation. While AI is different from existing technologies, it is still technology, and the service innovations it enables are still service innovations. Thus, the question arises: To what extent does AI change what one knows about service innovations, and how much can one build on findings from previous research when focusing on AI as an enabler of service innovation? This dissertation considers both AI-enabled innovations and those of any other kind. Studies uncover various similarities and differences between findings on AI-enabled innovations and general service innovation findings, highlighting the distinctive nature of AI-enabled service innovations.

First, building on the discussion of the findings in part 5.1, service innovation serves as a signal of service innovativeness that remains true for AI-enabled innovations. Changes in different service innovation dimensions have a positive impact on firm-level service innovativeness. Paper 4, which focuses on service robots, provides evidence that service innovation positively influences product-level service innovativeness. Thus, disregarding the enabling source of service innovation, service innovation has the potential to serve as a signal of service innovativeness on both the product and firm levels.

Second, when considering the relationship between interpretation and signaling outcome here (service innovativeness and consumer responses), there are some surprising outcomes for AI-enabled innovations. In the case of AI (Papers 4 and 5), the findings are not in line with the general model based on the literature (Paper 1). The literature review predicts a positive link between product-level service innovativeness and adoption (Paper 1). However, Paper 5 on service robots finds that fewer consumers are adopting service innovation, which more strongly signals service innovativeness (a higher degree of change in service innovation dimensions). These differences may come from the distinctive nature of AI (as studied in Paper 5) in comparison to other enablers of innovations considered in the general integrative framework of Paper 1. Indeed, recent studies (Frank et al., 2024; Zhang et al., 2021) suggest that consumers are hesitant to adopt AI, particularly in high-involvement services where the stakes are significant. This reluctance is linked to the amount of trust one places in AI (Hengstler et al., 2016). With greater potential loss and little trust in AI, people are more unwilling to rely on it (Zhang et al., 2021). Trust is connected with uncertainty and an understanding of the respective roles of the AI-enabled service and the consumer (Hengstler et al., 2016; Ostrom et al., 2019). As a result, consumers may find it easier to trust AI when it handles simpler tasks within less intelligent systems, as these are easier to comprehend, guiding consumers through service provision. Furthermore, because these lower-intelligence systems manage less complex tasks, they not only inspire more trust but also lead to less severe consequences of potential failure. From the perspective of signaling theory, AI as an enabler of service innovation can be seen as affecting the signaling environment. The culture of the consumer (Erevelles et al., 2001) can affect the signaling process and outcomes, as different values and characteristics lead not only to different interpretations but also to different signaling outcomes. Similarly, when AI enables service innovation, customer associations, beliefs, and the whole frame of reference change (C. R. Rogers, 1980). As consumers' frame of reference changes, the signaling environment can be considered different for A-enables services. Consumers become more averse and less willing to take the risk due to limited understanding and trust towards AI.

The third aspect worth discussing is strongly connected to the observed unintended negative impact of signaling through AI-enabled service innovations. AI-enabled service innovations as a signal can trigger such a signaling outcome as satisfaction. In both papers (Papers 4 and 5), with AI as an enabler of service innovation, satisfaction was found to be a consumer response. However, as discussed before, there was also a negative response in the form of lower adoption (Paper 5). Satisfaction can only be assessed after the adoption or use of the innovations (Liljander et al., 2006); thus, consumers may decide not to adopt innovations and therefore may not be able to experience their benefits. Considering the operationalization of satisfaction in a study on AI-enabled service innovations (Paper 5), the results are hard to comprehend. Online ratings served as a proxy of satisfaction; thus, they should serve as social proof for other consumers, leading to higher, not lower, adoption. The findings are in contradiction with previous studies (Gavilan et al. 2018; Jøsang et al. 2007; Naumzik et al. 2022), which claim that satisfaction, when operationalized as customers' ratings, can strengthen consumer trust in a product or service and, in turn, increase the number of customers. It seems that AI does not follow the patterns found in previous research; thus, it is interesting to understand what makes AI-oriented findings deviate from the available body of knowledge. Moreover, it is important to consider the possible reasons for AI to cause negative and positive responses at the same time. As this dissertation has not focused on this, I will use those findings as a starting point for recommending future research.

## 5.5 Limits of Signaling Theory

Signaling theory seems to serve well as a theoretical lens for this dissertation. This allowed me to add to the immediate findings of the papers and create a dissertation whose contribution goes beyond the contributions of the appended papers. While the theory enhances the understanding of the dynamics between service innovation and service innovativeness, this approach has some shortcomings.

First, service innovation is an ambiguous signal, so there is no universally recognized interpretation of such a signal. Even established signals, such as warranty or price, which are supposed to signal quality, are not always successful in conveying this information, depending on, for example, the culture of the consumer (Erevelles et al., 2001). Thus, as service innovation is rarely studied as a signal in the literature, there may be unexplored interpretations of service innovation that pose the risk of service innovativeness not being the only interpretation and possibly other interpretations being able to drive desirable behavior more than service innovativeness. This could imply that the proposed conceptual framework is not optimal, and findings could be influenced by other interpretations, resembling the omitted variable bias issue in statistics, yet applied to the conceptual framework. In statistics, such problems are often approached by considering the theoretical background of the model and, based on it, adding a possible explanatory variable. Yet, here, the problem comes from the theory and its scarce use in the context. However, this is hard to examine clearly, considering the subjective and intangible nature of the consumer's interpretation, which makes it challenging to capture.

The findings reveal relationships between firm- and product-level service innovativeness, which cannot be interpreted purely through signaling theory. Explaining this bidirectional link is not within the scope of the theory, as it does not consider the relationships between various interpretations but focuses solely on the link between signal, interpretation and outcome (Connelly et al., 2011). In that case, psychological theories are more appropriate for providing an explanation for the mechanism. These findings, with the possibility of two interpretations, add to concerns regarding the interpretation formation and the possible existence of an interpretation that is more strongly associated with further response.

Finally, considering AI as a difference in signaling environment while providing a general argument for the existence of different results between AI-enabled and usual service innovations is somewhat limited. Change in the environment indeed affects a signal's effect (Connelly et al., 2011), but the nature of the change and the reasons for the environmental change in one direction or another are beyond the scope of signaling theory. Thus, the nature of changes in the environment is considered by employing more recent empirical findings on AI in service settings (Frank et al., 2024; Zhang et al., 2021).

# 6. Conclusion

The purpose of this dissertation is to investigate and advance the understanding of service innovation and service innovativeness from a consumer viewpoint. I addressed three research questions on the relationships among service innovation, service innovativeness, and consumer responses while also considering the role of AI.

Service innovativeness, while present in the service literature, has not been well scrutinized. Using signaling theory (Spence, 1974) findings reveals that service innovations act as signals of service innovativeness: the greater the change in a service innovation, the stronger the signal. This position service innovation as a key antecedent of service innovativeness, explaining how these two concepts are connected from a theoretical standpoint.

Service innovativeness lacks a unified definition, so this work explores both product-level (e.g., Mu et al., 2018) and firm-level (e.g., Dotzel et al., 2013). Findings suggest that, though distinct, these are interrelated, share a common antecedent, which is service innovativeness, and produce similar consequences. These consequences are consumer responses—adoption, attractiveness, and satisfaction—to signaled service innovativeness.

Not all signaling outcomes are positive (Connelly et al., 2011). AI-enabled service innovations show a unique pattern: while perceived as highly innovative, they often lead to lower adoption but higher satisfaction. This suggests that AI, due to its limited maturity (J. Feng & Sears, 2010; Taylor & Taylor, 2012), introduces uncertainty, affecting trust (Venkatesh & Davis, 2000) and altering consumer reaction to signal service innovativeness. This highlights the temporal nature of signaling environments and aligns with the innovation diffusion model, where more people adopt innovations over time (E. M. Rogers, 1962).

## 6.1 Theoretical implications

This dissertation contributes to service research, particularly in service innovation and service marketing. Focusing on the influence of AI on how service innovations signal service innovativeness, I respond to recent calls for research into the evolving role of technology in service provision (Hollebeek et al., 2019), particularly AI, which has only recently been recognized as a service research priority (Ostrom et al., 2021). Below, I outline the main theoretical contributions of this work.

First, I advance the theoretical understanding of service innovativeness by clarifying its conceptual foundations and exploring its antecedents and consequences. Service innovativeness, while present in the literature (Dotzel et al., 2013; R. P. Lee et al., 2009; Zolfagharian & Paswan, 2009), is underexplored and suffers from a lack of conceptual clarity. I studied the two most common conceptualizations—product-level and firm-level service innovativeness—to find evidence suggesting their interdependency. I suggest that they are bidirectionally linked and share some common antecedents in the form of service innovations. This means that the greater the change in a service innovation dimension, the greater the service innovativeness at both the firm and product levels. Although this relationship may seem intuitive, there have hardly been any attempts to theoretically or empirically test it. To date, studies have either used service innovation and innovativeness interchangeably or treated one as a subpart of the other (Dotzel et al., 2013; R. P. Lee et al., 2009; Liu, 2013). While both product-level and firm-level service innovativeness bear some similarities, one needs to keep in mind that they are two distinct concepts. They have different scopes—single service offering vs. whole organization. I also extend the current knowledge by examining the consequences of service innovativeness. While Dotzel et al. (2013) found that firm-level service innovativeness positively influences satisfaction, I observed that this also holds true for product-level service innovativeness. Firm-level service innovativeness enhances relative attractiveness, which is consistent with the findings of Kurtmollaiev et al. (2022). Unlike in the case of product-level service innovativeness, no direct relationship between firm-level service innovativeness and adoption was found, but findings suggest that firm-level service innovativeness is a moderator of the relationship between product-level service innovativeness and adoption. Any possible shortcomings in product-level service innovativeness can be offset by firm-level service innovativeness, leading to more positive customer behavior (Kim et al. 2015). This means that the greater the firm-level service innovativeness, the more positive the relationship between product-level service innovativeness and adoption. However, product-level service innovativeness has led to conflicting findings concerning the adoption of service innovations, showing the importance of considering the nature of the service innovations to be adopted, as they may moderate the relationship.

Second, through the application of signaling theory, I offer both theoretical and empirical insights into how service innovation indirectly drives consumer responses, such as adoption, satisfaction, and relative attractiveness. Signaling theory, while broadly used in marketing and service research (e.g., L. Fan et al., 2021; Friske et al., 2023), has rarely been used to study service innovations (exceptions Hoang et al., 2025; Stock, 2011). This dissertation provides empirical evidence that service innovations act as signals of service innovativeness, which, in turn, shape consumer beliefs and behaviors. Unlike previous studies that primarily examined direct relationships between service innovation and consumer responses (Hoang et al., 2025; Mahmoud et al., 2017) or that focused on specific innovation characteristics (e.g., ease of use, perceived value) (B. C. Y. Lee, 2012; Truong, 2013), I introduce service innovativeness as a mediator that helps explain these effects. Using a signaling mechanism, I present an empirically tested and highly comprehensive theoretical articulation of how service innovations indirectly influence consumer responses.

Third, I contribute to the growing research on AI in services by exploring how AI-enabled service innovations differ in their signaling effects and consumer outcomes. While AI's role in service contexts is becoming increasingly prominent (Ostrom et al., 2021), there is still limited knowledge of how consumers interpret and respond to AI-enabled innovations. Consistent with findings by Frank et al. (2024) and Zhang et al. (2021), my results indicate that consumers tend to be more cautious in adopting AI-enabled service innovations. Specifically, based on the findings, I can conclude that greater service innovativeness is associated with lower adoption, contrary to patterns observed with conventional innovations where greater innovativeness typically enhances adoption. However, not everything differs between AI-enabled service innovations and conventional ones. In both cases, service innovation is still an effective signal of service innovativeness. AI-enabled service innovations also trigger positive responses by signaling service innovativeness. Similar to traditional service innovations, AI-enabled innovations still function as effective signals of service innovativeness and can lead to positive consumer responses, such as increased satisfaction. Thus, while both AI-enabled service innovations and conventional ones serve as signals of service innovativeness, the signaling outcomes can differ in the valence of the response. My findings suggest that AI is not only an objectively distinct enabler of innovation but is also perceived differently by consumers, adding a novel dimension to the literature on service innovation and AI in service delivery.

## 6.2 Managerial implications

Service innovations lure practitioners with great benefits, such as sales growth, profitability, and competitive advantage (Kurtmollaiev & Pedersen, 2022; Lin, 2013; Randhawa & Scerri, 2015). Today, one of the most prominent sources of service innovation is AI (Rust & Huang, 2014). With the rapid development of AI technologies and the growing availability of AI-enabled services, the implementation and design of AI-driven service innovations have become more accessible. However, as in the case of any investment with high possible returns, there is also a possibility of high loss, as the service innovation may fail (Gebauer et al., 2020; Humphries, 2018). Therefore, I offer the following guidance to help organizations benefit more from their service innovations.

First, firms need to recognize that service innovation is not only a functional improvement but that it also serves as a signal to consumers. This signal helps consumers make inferences about the firm and the services it offers, particularly in terms of service innovativeness. When used correctly, service innovation can positively influence consumer judgment, leading to satisfaction, adoption, and being viewed as more attractive than competitors. However, for a service innovation to serve as an effective signal, it needs to be strong. The strength of the signal depends on several factors that firms need to consider. Primarily, the greater the degree of change in service innovation dimensions, the stronger the signal of service innovativeness will be. Yet, this effect is also context dependent. Different service contexts may require an emphasis on different innovation dimensions to maximize signaling effectiveness. Thus, it is crucial to consider the context and choose the dimension of service innovation that will strengthen the signal rather than choose one that will dampen it. Online service providers should mostly prioritize the offering dimension, while physical retailers should emphasize innovations in the servicescape dimension alongside the offering.

Second, organizations must carefully consider the enablers of service innovation, particularly AI. The use of AI is becoming more prevalent and, in the long term, is expected to take over many tasks in organizations (Huang & Rust, 2021). Thus, it has naturally become a tool for driving innovation in services. However, simply using AI does not guarantee positive outcomes. AI-enabled service innovations can strongly convey service innovativeness, especially when the degree of change they cause is high, making them valuable for firms seeking to project an innovative image. However, findings suggest that while AI-enabled innovations trigger positive outcomes such as increased customer satisfaction, they may simultaneously lead to lower adoption rates. This contrasts with conventional innovations, which I considered, where higher perceived innovativeness typically results in greater adoption. Sending a strong signal in the form of AI-enabled service innovation does convey service innovativeness, and so for those who wish to gain an innovative image of their services or firm as a whole, it is an effective solution. However, signaled service innovativeness makes consumers reluctant to adopt service innovations when they are enabled by AI. Despite the negative outcome of this signaling in terms of adoption, there is still a positive signaling outcome, namely satisfaction. This means that AI-enabled service innovations trigger satisfaction by signaling service innovativeness.

Therefore, firms hoping for rapid adoption and a large-scale impact should be cautious about heavily signaling service innovativeness through AI-enabled innovations. In such cases, it may be more effective to implement more moderate changes, using AI to enhance less central dimensions of service innovation—thereby balancing negative and positive consumer responses. Conversely, for firms that are less focused on scale but aim to deliver superior and differentiated services, AI-enabled innovations offer an interesting solution. These firms can embrace AI as a means to increase satisfaction and differentiate themselves, even if adoption rates remain modest. In summary, practitioners must recognize that while service innovation—especially when enabled by AI—can signal service innovativeness, it does not guarantee uniform consumer responses. To fully benefit from service innovation, one needs a strategic approach that considers the degree of change, innovation dimension, and intended outcome (e.g., adoption vs. satisfaction).

## 6.3 Limitations and future research

Discussing the quality of the dissertation, I mentioned possible limitations, yet there are also some coming not from the methodological choices but from the context and nature of the studied phenomenon. I did not focus on a single context or systematically compare contexts. However, my findings suggest the dependence of the signal strength on the context studied. Thus, future research should compare contexts that implement AI-enabled changes in different service innovation dimensions. Considering the signaling environment can facilitate a more nuanced understanding of the general signaling mechanism, which I outlined.

None of my empirical studies examines both product- and firm-level service innovativeness together. The bidirectional relationship between different service innovativeness types was discovered in the literature review, as studies used one as the antecedent of another, yet

I did not test it empirically. Thus, I encourage empirical testing of this relationship. It would be beneficial to uncover what aspects influence whether the service innovation signal triggers service innovativeness at the firm or product level and whether there are any factors dependent on consumers or the service that impact what is signaled and how it is interpreted.

Additionally, it would be interesting to consider both AI-enabled services and other service innovations as signals in a single study. Perhaps the study of experimental design would more precisely point out the differences in the signaling effects of AI as an enabler of service innovations.

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# Papers

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Department of Management and Engineering
Division of Business Administration
Linköping University
SE-581 83 Linköping, Sweden
www.liu.se


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