Article

Big Data, Big Insights? Advancing Service Innovation and Design With Machine Learning

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Abstract

Service innovation is intertwined with service design, and knowledge from both fields should be integrated to advance theoretical and normative insights. However, studies bridging service innovation and service design are in their infancy. This is because the body of service innovation and service design research is large and heterogeneous, which makes it difficult, if not impossible, for any human to read and understand its entire content and to delineate appropriate guidelines on how to broaden the scope of either field. Our work addresses this challenge by presenting the first application of topic modeling, a type of machine learning, to review and analyze currently available service innovation and service design research ($n = 641$ articles with 10,543 pages of written text or 4,119,747 words). We provide an empirical contribution to service research by identifying and analyzing 69 distinct research topics in the published text corpus, a theoretical contribution by delineating an extensive research agenda consisting of four research directions and 12 operationalizable guidelines to facilitate cross-fertilization between the two fields, and a methodological contribution by introducing and demonstrating the applicability of topic modeling and machine learning as a novel type of big data analytics to our discipline.

Keywords

Big data, research agenda, service innovation, service design, topic modeling

Introduction

A classic tale describes how a group of blind men attempt to determine what an elephant looks like. After each man touches a different part of the animal (e.g., its leg, tusk, or ear), disagreement arises, since all men claim to be the only one to understand the elephant's true appearance. When a sighted man explains the situation to the group, the men learn they are blind and that none of them described the elephant correctly. As such, the tale illustrates the inexpressible nature of truth; every men's subjective perception of the elephant was true. But it was also incorrect, since the whole is greater than the sum of its parts.

The current state of service innovation and service design research resembles characteristics that are similar to the tale involving the "blind men and the elephant." For one, service innovation research is heterogeneous and largely disconnected. Multiple disciplines such as service marketing (e.g., Agarwal, Erramilli, and Dev 2003), information systems research (e.g., Swanson 1994), or innovation management (e.g., Gallouj and Weinstein 1997), all aimed to explore service innovation as a phenomenon of interest. And, just like the men in our introductory tale, researchers within these disciplines attempted to determine what service innovation entails by applying their own discipline-specific theoretical lenses or paradigms. For example, Greenhalgh et al. (2004) review service innovation research within health care, Breidbach and Maglio (2015) explore service innovation for information systems research, while Carlborg, Kindström, and Kowalkowski (2014) review service innovation studies within marketing. Similarly, service design research spans disciplines ranging from management (e.g., Das Gupta, Karmarkar, and Roels 2016), operations research (e.g., Pullman, Verma, and Goodale 2001), over marketing (e.g., Tax and Stuart 1997) to information systems research (e.g., Glushko and Tabas 2009). And while all of these contributions do, individually, advance insights within their disciplines, service innovation and service design research may have, just like the blind men who touched individual parts of the elephant only, lost track of the bigger picture. Gallouj and Windrum's (2009, p. 141) earlier statement that service research "requires a thorough review of what (we think) we know about innovation" therefore still appears to be valid today.

The increasing complexity of service innovation and service design implies that prior attempts to advance theoretical or normative insights through a singular disciplinary lens are no

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longer sufficient (Maglio, Kieliszewski, and Spohrer 2010). Carlborg, Kindström, and Kowalkowski (2014) as well as Ostrom et al. (2015) acknowledge in this context that service innovation research is intertwined with service design, and that knowledge from both fields should be integrated to advance the current discourse more holistically. And while moving away from established disciplinary silos may be challenging (Ostrom et al. 2015), breaking down existing boundaries is crucial to facilitate the generation of new knowledge (Larson 2016). In fact, this approach may, just like the sighted men, help us understand that the available knowledge is greater than the sum of its parts. Furthermore, service design research is considered to be particularly suitable to stimulate new knowledge about service innovation because it transcends prior firm centric and functionality-driven approaches that dominated much of the extant service innovation discourse (e.g., Edvardsson et al. 2000). This is because service design adopts a human-centric perspective to understand customers, contexts, and social practices (Kimbell 2011), as well as their interactions and experiences within service systems (Patrício et al. 2011; Zomerdijk and Voss 2010). Consequently, leveraging service design to foster service innovation emerged as a key priority for service research today (Ostrom et al. 2015). However, the important intersection of service design and service innovation research remains largely unexplored (e.g., Wetter-Edman et al. 2014; Andreassen et al. 2016).

We argue that research bridging service innovation and service design is in its infancy due to the lack of operationalizable guidelines on *how* to broaden the scope of either field. Ultimately, without clear directions on how to integrate knowledge currently held in disconnected silos, calls to expand the boundaries of service innovation and service design research remain mere rhetoric. We furthermore argue that the lack of operationalizable guidelines is rooted in the complexity of the existing service innovation and service design literature. Specifically, the large volume, variety, and velocity of the current body of knowledge resembles an instance of a big data set (George, Haas, and Pentland 2014), which makes it difficult, if not impossible, for any single human to read and understand its entire content and to delineate conclusions. Wetter-Edman et al. (2014) and Witell et al. (2015) already suggested that new approaches and methods may be needed to advance service innovation and service design research. And while information systems researchers have begun to apply big data analytics as a novel research method (e.g., Müller et al. 2016), using big data analytics to uncover opportunities for service innovation remains yet another unresolved service research priority today (Ostrom et al. 2015).

The current academic debate, as exemplified in this special issue of the *Journal of Service Research* (*JSR*), aims to advance knowledge pertaining to service innovation and service design research. Our present study therefore provides the, to the best of our knowledge, very first application of big data analytics to advance service innovation and service design research. Specifically, using a topic modeling algorithm allows us to (i) review and analyze all service innovation and service design research articles published between 1986 and 2016 in business and economics journals listed by Thompson Reuters' *Web of Science* ($N = 641$). This interdisciplinary text corpus consists of 10,543 pages of written text or 4,119,747 words, which we consider a suitable example for a big data set to be encountered in other service contexts (e.g., Rust and Huang 2014). The results of this analysis enable us to (ii) provide tangible pathways for future researchers aiming to integrate service innovation and service design research. Our study thereby provides three important contributions.

First, our review and analysis of existing service innovation and service design research identifies 69 distinct research topics in the published text corpus, assesses the relevance of each topic, and estimates topic development trajectories over the last decades. We furthermore illustrate the topic landscape using a network graph and highlight how, and through which topics, service innovation and service design research are interconnected, and where gaps in knowledge exist. As such, our empirical analysis extends the scope and scale of existing service innovation reviews that focused on specific disciplines such as marketing (e.g., Carlborg, Kindström, and Kowalkowski 2014), contexts such as public services (e.g., Djellal, Gallouj, and Miles 2013), or the service innovation concept itself (e.g., Snyder et al. 2016) but omitted service design from their analyses. We summarize our findings through four key insights that provide a much-needed big picture overview of the two fields that is relevant to novice scholars end experts alike. As such, our empirical contribution directly addresses Gallouj and Windrum's (2009) call for a thorough reassessment of existing knowledge in the field.

Second, we provide a theoretical contribution to service innovation and service design research through an empirically derived research agenda that consists of 4 research directions, 28 exemplary research questions, as well as 12 operationalizable research mechanisms that can be applied by future researchers to our topic model and data set in order to identify additional research opportunities and questions. Our research agenda thereby aims to facilitate the cross-fertilization of service innovation and service design research by enabling future researchers to (1) integrate extant service innovation and service design research across topics, (2) generalize knowledge across both fields, (3) expand the theoretical scope of service innovation and service design research, and (4) apply new methods in service innovation and service design research. Our study thereby directly addresses calls to integrate research in both fields (e.g., Andreassen et al. 2016; Ostrom et al. 2015), by developing the much-needed guidance to do so.

Third, our present work extends the established methodological repertoire in service research by introducing and demonstrating the applicability of topic modeling as a specific type of machine learning to the discipline. Specifically, we provide future service researchers and practitioners attempting to benefit from "big" natural language data sets with a blueprint on how to use new research methods commonly associated with big data analytics (e.g., Rust and Huang 2014). Our application of topic modeling to the current body of published service

innovation and design research, and subsequent analysis thereof directly, addresses Ostrom et al.'s (2015) service research priorities of (1) using big data to advance service, (2) advancing and stimulating service innovation, and (3) leveraging service design. By applying insights from computer science in service research, we furthermore provide the much-needed interdisciplinary perspective needed to leverage the benefits of big data for service innovation (Ostrom et al. 2015). At the same time, we address calls to integrate service innovation and service design research through new methods (e.g., Wetter-Edman et al. 2014; Witell et al. 2015; Andreassen et al. 2016), and demonstrate how this might be accomplished.

This article is organized as follows: We initially explain how we used topic modeling to analyze the established body of service innovation and service design research, before presenting the findings of our analysis. Our work then delineates an extensive research agenda that can help to integrate future service innovation and service design research and discuss the implications and contributions of our approach for service research.

Analyzing the Corpus of Service Innovation and Service Design Research With Machine Learning

Prior reviews and analyses of service innovation research appeared in a variety of disciplines, ranging from technology and innovation management (e.g., Drejer 2004), to marketing (e.g., Carlborg, Kindström, and Kowalkowski 2014), or economics (e.g., Djellal, Gallouj, and Miles 2013).[1] And while many of the early service innovation review studies did not follow a systematic method to analyze the then current body of knowledge (e.g. Drejer 2004), thus limiting their replicability, more recent work evolved significantly in this regard. For example, Sakata et al. (2013) use a computational, and therefore fully replicable, approach to identify author citation networks across 57,928 articles broadly associated with service innovation research, while Witell et al. (2016) rely on qualitative as well as quantitative content analyses to identify the key characteristic of service innovation definitions across a final sample of 84 articles. We therefore agree with Biemanns et al. (2016) who argue that service innovation research does not need another manual review of the literature. Instead, we build upon the precedence set by previous studies that used computational methods and aim to expand the scale and scope of currently available service innovation reviews even further. Specifically, our objective is to "take stock" of the body of currently available service innovation *and* service design research and to identify pathways for how both fields could be integrated. This text corpus necessarily resembles the characteristics of a big data set (George, Haas, and Pentland 2014) so that a new computational method is needed. Machine learning in general, and topic modeling in particular represents such a new approach.

Machine learning is a field that develops methods capable of automatically uncovering, mapping, and organizing themes and trends in big data sets (e.g., Blei 2012). For example, large volumes of written text or other instances of natural language too big for manual analysis (e.g., the entire text corpus of published service innovation and service design research). More specifically, so-called topic modeling algorithms can automatically identify, quantify, and describe the topics discussed within a document (e.g., an article published in a journal), investigate the similarity between documents forming large text corpora (e.g., all articles published in a journal), or their thematic association (Griffiths and Steyvers 2004).

Here, we use Latent Dirichlet Allocation (LDA), the most established topic-modeling algorithm available today (Blei, Ng, and Jordan 2003). LDA assumes that any digital document represents a collection of topic bundles and is characterized by a particular topic distribution. For example, LDA would assume that the corpus of approximately 700 articles published in the JSR to date covers a largely homogenous list of topics related to service research (e.g., service innovation, service quality). However, individual articles (e.g., Ostrom et al. 2015) are heterogeneous regarding their topics. Identifying and assigning topics to all *JSR* articles would therefore result in a distinct distribution of topics across articles. For a single article, such distribution would indicate which topic(s) the article addresses and which ones it does not. We explain the technical details of LDA in Online Appendix 3 and now outline how we used it.

Article Selection and Corpus Creation

We followed the precedence of other literature reviews and meta-studies (e.g., Nerur, Rasheed, and Natarajan 2008; Di Stefano, Gambardella, and Verona 2012) and used Thompson Reuters' *Web of Science* to identify the corpus of service innovation and service design research published in business and economics journals. The *Web of Science* is the "most comprehensive database for scholarly work" (Dahlander and Gann 2010, p. 700), and its Social-Science-Citation-Index provides access to peer-reviewed journals, thereby ensuring scholarly quality (e.g., Eom 2009). Finally, unlike other databases, the search results in the *Web of Science* are not constrained by institutional (e.g., university) journal subscriptions. Other scholars can therefore replicate our study, and generate the same dataset, if using identical search terms.

Like Witell et al. (2016) and Snyder et al. (2016) before us, we searched for all articles that contained either "service* innovation*" or "innovation* in service*" in the title, the abstract, or the author key words. In order to identify similarities and differences between service innovation and service design research, we also searched for articles that contained "service* design*." However, unlike other service innovation review studies (e.g., Biemans, Griffin, and Moenart 2016), we did not include "new service development" as a search term because growing evidence suggests this concept differs from both service innovation and service design (e.g., Patricio et al.

2011; Witell et al. 2016). Focusing on articles written in English only, we excluded all editorial material, letters, and book reviews. We then extracted all available information from *Web of Science*, including titles, author names, the journal title, and number of citations before downloading the full text using EBSCO and EMERALD repositories as well as journal homepages. This process resulted in a set of 641 articles, consisting of 10,543 pages of text or 4,119,747 words for analysis. Our text corpus thereby compares favorably to the final sample sizes of 45 (Snyder et al. 2016), 128 (Carlborg, Kindström, and Kowalkowski 2014) or 201 (Biemans, Griffin, and Moenart 2016) articles analyzed by prior service innovation reviews.

Text Preprocessing

We preprocessed our text corpus following procedures by Antons, Kleer, and Salge (2016). First, we used optical character recognition software to convert each document from portable document format (pdf) into raw text. Second, in order to unify the textual data, we applied typical means (Blei and Lafferty 2007), which involved converting all text to lower case, excluding punctuation, and removing a standard list of meaningless "stopwords" (e.g., "she," "the," "thus") as well as terms that were used in less than 0.1% of all articles. Furthermore, since words can be used in several forms (e.g., due to their grammatical tense), such variations can introduce large word variability, which is undesirable when attempting to identify topics. We therefore, third, reduced all remaining words to their word stem (e.g., "service," "services," and "served" were reduced to their stem "serv*").

Fourth, following Blei, Ng, and Jordan (2003), we identified n-grams in all documents. An n-gram is defined as a sequence of words from a given sequence of text. In English, word sequences can form compounds that generate new meaning. For example, "service innovation" and "service design" are such compounds. Since LDA neglects the order of words in documents, the structure and deeper meaning of these compounds could be missed. We therefore substituted word stems with n-gram terms, using Wang, McCallum, and Wei's (2007) algorithm.

Fifth, we prepared the input matrix for LDA, a document-term matrix that replaces terms and word stems with indices, thereby highlighting how often these occur in each document of the corpus. This resulted in a matrix containing all 641 articles and all 13,687 word stems and n-grams. Although we took into consideration that n-grams merge single words into compounds, preprocessing eliminated 2,641,120 term occurrences by excluding stop words, infrequent terms, and by stemming all remaining words.

Finally, we reduced the size of our document-term matrix to avoid computational problems during the LDA analysis. We followed best practices for text mining (e.g., Blei and Lafferty 2009) and excluded all terms with low discriminatory power using the "term frequency–inverse document frequency" value (tf-idf; see Wu et al. 2008). Here, we included only those terms whose tf-idf exceeds the median of all tf-idf values (Antons, Kleer, and Salge 2016), because these terms distinguish individual documents. Our final document-term matrix contained 641 research articles and 6,544 terms that reflect upon 184,290 words and n-grams.

Topic Extraction, Labeling, and Classification

We used Hornik and Grün's (2011) "topicmodels" package, an add-on for the statistical software R, to extract topics from our corpus of published service innovation and design research. Following Griffith and Steyvers' (2004) suggestion to use Gibbs sampling to estimate the LDA model (i.e., the posterior distribution of the topics), we determined the ideal number of topics from our text corpus. This process indicated that 69 distinct topics best describe the overall topic landscape of currently published service innovation and service design research. However, while LDA identifies the individual topics in a text corpus, the associated terms, and the topic loadings of all documents, it does not generate a label to describe each topic (Blei 2012). The labeling of LDA outputs thus still requires some human input (Bao and Datta 2014). We subsequently extracted the top 15 terms associated with each topic as well as the titles, abstracts, and key words of all articles loading highly on the respective topic, and identified all articles with a meaningful topic loading by applying Antons, Kleer, and Salge's (2016) 10% cutoff value. Both authors used this information to independently assign descriptive labels to each topic. We compared our initial results, which led to either identical or very similar labels for 57 of the 69 individual topics that the LDA algorithm identified. We then tested this outcome by following Miles and Huberman's (1994) suggestion to determine an intercoder reliability measure. The result of 82% was well above Miles and Huberman's (1994) recommendation of an initial 70% value. After discussing the remaining 12 topics, we consolidated our topic labels, ensured none were discriminatory, and developed a classification scheme to describe the structure of the topic collection. Again, every author initially classified topics independently before we compared and consolidated results, this time resulting in an intercoder reliability measure of 98%. Our scheme classifies topics as a *theoretical lens* (e.g., topics containing theories and theory-like edifices of arguments), a *phenomenon* that is studied, a *context*, and *research method* to study service innovation and design, a *managerial tool*, or a *cross-cutting theme* that spans two or more of the other topics. Finally, we tested the reliability of our topic labels and classification with an external panel of scholars familiar with the wider service innovation and service design literature, which did not result in any changes.

Topic Trajectories and Network Structure

We created a dynamic landscape of our topic structure to show how extant service innovation and service design research evolved, overlap, and to identify possible future trajectories. Specifically, we computed linear time trends using the annual number of published articles per topic by means of Stata 13.1,

which enabled us to point out patterns of topics that grow and decline. We denote topics as "hot" whenever they exhibit a positive linear time trend or as "cold" for negative trend coefficients (following Griffiths and Steyvers 2004). We then portrayed the entire network of existing service innovation and design research topics. To do so, we represented all 69 topics as nodes and linked these with edges whenever individual topics appeared together in one article with a topic loading above Antons, Kleer, and Salge's (2016) 10% cutoff. Using Stata 13.1, we calculated standard measures from network analysis such as network density, node degree, and betweeness. Finally, we visualized the network using the Gephi software.

The Topic Landscape of Service Innovation and Service Design Research

The currently available 641 service innovation and service design articles that we obtained from Thompson Reuters *Web of Science* for our analysis were published by 148 different journals. And while each journal issued, on average, 4.33 articles, the distribution of articles to journals is highly skewed. In fact, the majority of articles was published by just 18 journals, with the *Service Industries Journal* (59 articles), the *Journal of Service Management* (37 articles), and the *JSR* (25 articles) leading this list. More importantly, of 641 articles, 463 articles (approx. 72%) are positioned by the author(s) within the service innovation literature, 165 articles (approx. 25%) are positioned as service design contributions, and only 13 articles are positioned in both research fields by referring to service innovation *and* service design in the title, the abstract, or key words. Put differently, only *2*% of articles to date attempted to integrate service innovation and service design research, which supports recent calls for a better integration of service innovation and service design research (e.g., Andreassen et al. 2016).

In what follows, we (i) map and describe the topic landscape of service innovation and service design research to date; (ii) compare the research topics, their temporal trajectories, as well as research methods, and (iii) analyze the resulting topic network to assess the extent to which service innovation and service design research currently overlap. We subsequently deduct four key insights to summarize our findings. These provide an important big picture overview for experts and novice scholars alike, before we discuss our findings in the following section, while also developing an agenda to integrate future service innovation and design research.

Insight 1: Service innovation and service design research to date explored 69 topics. This research landscape is dominated by phenomenological rather than theoretical topics.

The LDA algorithm inferred 69 unique topics from our text corpus. Table 1 introduces this topic landscape, including (1) the label assigned to each topic, (2) the topic classification, (3) the number of articles and their distribution across topics[2], and (4) the temporal trajectory of each topic.[3]

We found that between 5 and 59 articles are associated with any given topic and that the mean number of articles associated with a topic is 16. Table 1 also presents the years in which the first and last article for each topic was published, the mean publication year, and the coefficient of a trend regression for the number of published articles over time. Overall, the oldest topic is Scale Development (#45) with an average publication year of 2004.4, while the newest topic is Service Innovation in the Digital Age (#20), with an average publication year of 2014.6. Furthermore, topics such as Designing Service Experience (#54) or Transformative Service Research (#69) exhibit strong positive time trends, which indicate a recent incrase in interest.

The 69 topics represent 7 *theoretical* perspectives (e.g., topics containing theories and theory-like edifices of arguments like SD-logic), 19 *phenomena* (e.g., servitization), 12 *research contexts* (e.g., healthcare), while 8 represent either *research methods* or *tools* (e.g., case studies). Finally, we classified 19 topics as *cross-cutting* (e.g., service innovation success factors) because they address multiple categories. However, just 7 of 69 topics (approximately 10%) explicitly rely upon or build theoretical perspectives, which indicates that the theoretical scope of both fields may be limited.

Insight 2: The extent to which service innovation and service design research contributed to each topic varies considerably. Only service innovation research contributed to every topic.

The Herfindahl Index[4] enabled us to differentiate between topics dominated by articles positioned as service innovation (approximately 62%), service design (approximately 16%), and those that influenced by both service innovation *and* service design research (approximately 21%). And while service innovation research contributed to every topic, we identified 16 topics service design research has not contributed to at all. These include Knowledge Sharing and Exchange (#13), Knowledge Sourcing for Service Innovation (#14), or Service Innovation and Firm Performance (#65). Among these 16 topics, theoretical perspectives like Absorptive Capacity (#1), Dynamic Capabilities (#2), and Market Orientation (#3) have not been used by service design researchers in their inquiries. However, SD-Logic (#6) and Organizational Capabilities for Service Innovation (#5) represent exceptions that received some attention from service design research. Furthermore, of 70 articles addressing topics categorized as managerial tools (e.g., Applying Design Thinking in Service Context [#47] or Service Blueprinting and Modeling [#49]), 48 are clearly dominated by service design.

Insight 3: The topics of service innovation and service design research differ regarding their methodological maturity. Service innovation research is more mature than service design and more likely to use quantitative methods to address topics relevant to an academic audience. In contrast, service design is less mature, relies predominantly on qualitative and conceptual research, and investigates topics that are of managerial relevance.

Research topics evolve over time and so do the methods researchers use. However, no systematic review to date analyzed and compared the methods used within service innovation and service design research. This represents a significant

Table 1. The Service Innovation and Design Research Topic Landscape and Its Temporal Trajectories.

Topic Number	Topic Label	Topic Classification	Count of all Articles With Loading >10%	Count of Service Innovation Articles	Count of Service Design Articles	Herfindahl Index	Focus	Publication Year of Articles With Loading >10%				
								Mean	*SD*	*Minimum*	*Maximum*	*Linear Time Trend*
1	Absorptive Capacity	Theoretical Lens	7	7	0	1.00	Service Innovation	2012.71	2.56	2008	2015	0.0833
2	Dynamic Capabilities and Service Innovation	Theoretical Lens	11	11	0	1.00	Service Innovation	2013.00	1.84	2010	2015	0.0000
3	Market Orientation	Theoretical Lens	13	13	0	1.00	Service Innovation	2010.69	4.84	1996	2016	0.0792*
4	Microeconomic Perspectives on Service Innovation	Theoretical Lens	6	4	2	0.56	both	2009.83	4.96	2000	2013	0.0270
5	Organizational Capabilities for Service Innovation	Theoretical Lens	30	24	6	0.68	Service Innovation	2009.87	4.90	1997	2016	0.1519***
6	SD-Logic	Theoretical Lens	29	21	11	0.67	Service Innovation	2013.41	1.82	2009	2016	0.6310
7	Service Science Lens on Innovation	Theoretical Lens	17	16	3	0.92	Service Innovation	2008.24	4.88	1992	2013	0.0543
8	Adoption of Service Innovation	Phenomenon	25	21	4	0.73	Service Innovation	2011.28	4.62	1998	2016	0.1877***
9	Business Models	Phenomenon	13	11	2	0.74	Service Innovation	2011.69	3.30	2005	2016	0.1084
10	Coordination of Health Service Networks	Phenomenon	8	3	5	0.53	both	2010.88	5.30	1999	2016	0.0557*
11	Impact of Service Innovation on Customer Loyalty	Phenomenon	9	9	0	1.00	Service Innovation	2012.67	2.12	2010	2015	−0.1071
12	Innovation Practices in the Hotel Industry	Phenomenon	18	14	4	0.65	Service Innovation	2011.72	2.54	2009	2016	−0.3333
13	Knowledge Sharing and Exchange	Phenomenon	11	11	0	1.00	Service Innovation	2012.82	1.72	2010	2015	−0.0714
14	Knowledge Sourcing for Service Innovation	Phenomenon	18	18	0	1.00	Service Innovation	2012.33	2.38	2007	2016	0.1818
15	Learning from Service Failure	Phenomenon	8	5	3	0.53	both	2011.00	4.31	2001	2015	0.0588
16	Management Challenges in Service	Phenomenon	11	6	6	0.60	both	2010.55	4.93	2000	2016	0.0686*
17	Managing Service Innovation Projects	Phenomenon	15	15	2	1.02	Service Innovation	2010.00	6.68	1995	2016	0.0762**
18	Service Architecture and Modularization	Phenomenon	11	5	7	0.61	Service Design	2012.82	2.18	2009	2016	0.0833
19	Service Encounter	Phenomenon	24	7	17	0.59	Service Design	2009.33	5.07	1995	2016	0.1039**
20	Service Innovation in the Digital Age	Phenomenon	15	14	1	0.88	Service Innovation	2014.60	1.12	2012	2016	0.9000
21	Service Innovation through Optimization	Phenomenon	15	4	11	0.61	Service Design	2008.67	5.63	1996	2016	0.0519**

(continued)

Table 1. (continued)

Topic Number	Topic Label	Topic Classification	Count of all Articles With Loading >10%	Count of Service Innovation Articles	Count of Service Design Articles	Herfindahl Index	Focus	Publication Year of Articles With Loading >10%				
								Mean	*SD*	*Minimum*	*Maximum*	*Linear Time Trend*
22	Service Process Design	Phenomenon	14	5	10	0.64	Service Design	2005.93	5.44	1997	2015	−0.0120
23	Service System Reforms as Innovations	Phenomenon	11	7	4	0.54	both	2008.09	3.88	2003	2013	−0.0681
24	Servicescapes	Phenomenon	15	3	12	0.68	Service Design	2008.80	6.92	1997	2016	0.0519
25	Servitization	Phenomenon	19	17	2	0.81	Service Innovation	2012.16	2.39	2007	2016	0.1515
26	User Innovation in Service	Phenomenon	11	11	0	1.00	Service Innovation	2013.46	1.81	2011	2016	−0.0286
27	E-Commerce	Context	14	9	5	0.54	both	2011.36	3.59	2002	2015	0.1179
28	Emerging Economies	Context	6	6	0	1.00	Service Innovation	2011.50	3.27	2006	2016	0.0273
29	Entrepreneurship	Context	18	16	2	0.80	Service Innovation	2011.50	5.03	1997	2016	0.1353***
30	Financial Services	Context	16	13	3	0.70	Service Innovation	2004.56	7.34	1992	2015	0.0020
31	Healthcare	Context	42	28	15	0.57	both	2010.36	4.65	1999	2015	0.2477**
32	Hospitality and Tourism	Context	17	16	1	0.89	Service Innovation	2011.12	2.57	2005	2015	0.0734
33	Knowledge-intensive Business Service	Context	14	13	1	0.87	Service Innovation	2011.71	3.17	2005	2016	0.1189
34	Public Service Innovation	Context	22	17	5	0.65	Service Innovation	2011.68	4.81	1998	2016	0.1807***
35	Service Innovation in Local Municipalities	Context	6	5	1	0.72	Service Innovation	2008.33	7.34	1995	2016	0.0192
36	Service Innovation in SMEs	Context	11	8	3	0.60	Service Innovation	2012.73	2.61	2008	2016	0.1333
37	Service Innovation in Value Networks	Context	11	11	0	1.00	Service Innovation	2014.00	1.10	2012	2015	0.0000
38	Transportation	Context	18	4	15	0.74	Service Design	2008.67	7.26	1993	2016	0.0645***
39	Applications of Cluster Analysis	Research Method	12	12	0	1.00	Service Innovation	2012.00	2.26	2009	2016	−0.1429
40	Approaches to identify Causal Relationships	Research Method	5	3	2	0.52	both	2012.60	1.67	2011	2015	0.3077*
41	Case Studies	Research Method	11	4	8	0.66	Service Design	2008.18	6.95	1993	2015	0.0343*
42	Conjoint and Discrete Choice Analysis	Research Method	15	4	11	0.61	Service Design	2007.07	6.84	1997	2015	0.0128

(continued)

Table 1. (continued)

Topic Number	Topic Label	Topic Classification	Count of all Articles With Loading >10%	Count of Service Innovation Articles	Count of Service Design Articles	Herfindahl Index	Focus	Publication Year of Articles With Loading >10%				
								Mean	*SD*	*Minimum*	*Maximum*	*Linear Time Trend*
43	Covariance-based Structural Equation Modeling	Research Method	59	52	8	0.80	Service Innovation	2012.83	2.31	2004	2016	0.9176***
44	Partial Least Squares	Research Method	13	13	0	1.00	Service Innovation	2013.23	2.20	2009	2016	0.2262
45	Scale Development	Research Method	7	6	1	0.76	Service Innovation	2004.43	8.75	1993	2014	−0.0036
46	Synthesizing Service Innovation Literature	Research Method	21	21	0	1.00	Service Innovation	2007.52	5.73	1995	2014	0.0480
47	Applying Design Thinking in Service Context	Managerial Tool	7	5	2	0.59	both	2009.29	7.02	1996	2016	0.0299*
48	Optimizing Service Attributes	Managerial Tool	19	5	15	0.69	Service Design	2010.32	5.95	1997	2016	0.1090**
49	Service Blueprinting and Modeling	Managerial Tool	28	8	24	0.82	Service Design	2010.43	4.68	1996	2016	0.1610***
50	Total Quality Management	Managerial Tool	16	9	7	0.51	both	2008.75	7.86	1991	2016	0.0569**
51	Comparing Service Innovation by Incumbents and Start-Ups	Cross-Cutting Theme	19	19	0	1.00	Service Innovation	2009.05	5.43	1995	2016	0.0762**
52	Cross-Cultural Differences and Service Innovation	Cross-Cutting Theme	11	8	3	0.60	Service Innovation	2012.82	2.32	2009	2016	0.0833
53	Customer Involvement and Relationship Management	Cross-Cutting Theme	17	12	5	0.58	both	2012.94	2.95	2004	2016	0.2747**
54	Designing Service Experiences	Cross-Cutting Theme	24	14	10	0.51	both	2012.83	3.07	2004	2016	0.3736***
55	Guiding Service Innovation Research and Practice	Cross-Cutting Theme	13	13	1	1.01	Service Innovation	2010.00	2.77	2006	2015	−0.1182
56	Knowledge Management for Service Innovation	Cross-Cutting Theme	10	9	1	0.82	Service Innovation	2007.10	4.43	1997	2011	0.0090
57	Linking Service and Product Innovation	Cross-Cutting Theme	6	5	1	0.72	Service Innovation	2006.83	5.74	1996	2012	0.0065
58	Measuring Innovation in Service	Cross-Cutting Theme	48	48	0	1.00	Service Innovation	2010.23	4.51	1997	2016	0.2692***
59	Measuring Service Innovation Performance	Cross-Cutting Theme	8	5	3	0.53	both	2008.50	6.99	1993	2015	0.0274
60	New Service Development	Cross-Cutting Theme	23	17	6	0.61	Service Innovation	2009.61	5.78	1992	2015	0.0999***
61	Path Dependency in Service Innovation	Cross-Cutting Theme	6	4	2	0.56	both	2007.83	7.63	1996	2015	0.0143
62	Planning and Execution of Service Innovation	Cross-Cutting Theme	9	9	0	1.00	Service Innovation	2011.00	4.72	2002	2015	0.0643
63	Sectoral Patterns of Service Innovation	Cross-Cutting Theme	24	24	0	1.00	Service Innovation	2007.17	6.93	1986	2015	0.0569**

(continued)

Table 1. (continued)

Topic Number	Topic Label	Topic Classification	Count of all Articles With Loading >10%	Count of Service Innovation Articles	Count of Service Design Articles	Herfindahl Index	Focus	Publication Year of Articles With Loading >10%				
								Mean	*SD*	*Minimum*	*Maximum*	*Linear Time Trend*
64	Service Channels	Cross-Cutting Theme	14	2	12	0.76	Service Design	2010.50	3.11	2006	2015	−0.0636
65	Service Innovation and Firm Performance	Cross-Cutting Theme	19	19	0	1.00	Service Innovation	2012.05	4.71	1996	2016	0.1494***
66	Service Innovation and Policy Implications	Cross-Cutting Theme	21	21	0	1.00	Service Innovation	2010.24	5.37	1999	2016	0.1187***
67	Service Innovation Competencies	Cross-Cutting Theme	12	11	2	0.87	Service Innovation	2013.25	1.71	2010	2015	0.1071
68	Service Innovation Success Factors	Cross-Cutting Theme	11	11	0	1.00	Service Innovation	2010.91	5.91	1995	2015	0.0672**
69	Transformative Service Research	Cross-Cutting Theme	14	9	5	0.54	both	2013.64	2.98	2005	2016	0.3077*

Notes. $N = 641$. Broken lines indicate the different topic classes.
*$p < .10$. ** $p < .05$. *** $p < .01$.

Table 2. Research Designs in Service Innovation and Design Research.

	Overall		Service Innovation		Service Design	
Research Design	Number of Articles	%	Number of Articles	%	Number of Articles	%
Conceptual studies	122	19.03	90	18.91	37	22.42
Qualitative studies	197	30.73	136	28.57	53	32.12
Quantitative studies	280	43.68	231	48.53	51	30.91
Experimental studies	10	1.56	5	1.05	5	3.03
Modelling and simulation studies	26	4.06	11	2.31	16	9.70
Mixed methods studies	6	0.94	3	0.63	3	1.82
Total	641	100.00	476	74.26	165	25.74

Note. We included the 13 studies bridging the domains in the descriptives of both research streams.

gap in knowledge because understanding the link between research topics and methods enables us to determine the maturity of each topic and to identify future research opportunities. Here, we build on the work by Laudan (1981) to argue that new research topics in any field associated with the wider social sciences (i.e., service innovation) typically start with conceptual or exploratory qualitative work before quantitative research designs aim to test theory once a topic matures. In order to determine topic maturity, we subsequently aimed to understand which research methods are applied across topics. Table 2 explains that empirical service innovation and service design research predominantly relied upon established quantitative or qualitative methods (74.41%), with Table 3 linking methods to research topics. The percentage of quantitative studies (e.g., those using regressions) is significantly higher in service innovation (48.53%) than service design research (30.91%). In contrast, conceptual and qualitative research is more common in service design (54.55%) than service innovation research (47.48%). Advanced research methods like experiments or simulations are significantly less common overall (6.55%), thus indicating potential future research pathways.

Topics like Market Orientation (#3) or Service Innovation and Firm Performance (#65) are relatively mature and thus dominated by quantitative studies, while emerging topics like SD-Logic (#6) and Service Science Lens on Innovation (#7) rely mainly on conceptual and qualitative work. Growth topics where a broad range of research methods are applied include Learing from Service Failure (#15) and Service Encounter (#19). These findings are also supported by the Herfindahl Index. The time trends in Table 1 further support this finding and indicate that 14 of 43 service innovation topics (approx imately 32 percent) exhibit a positive and significant time trend. Conversely, in service design, 6 of 11 topics (approx imately 54%) reveal this trend.

Insight 4: The topic network of service innovation and service design research is only loosely connected. This indicates that both fields are far from being consolidated.

We created a topic network consisting of 69 nodes (each representing a topic) and 382 edges (each representing a link between topic pairs) to understand the extent to which service innovation and service design research are integrated. Figure 1 illustrates the topic network. *Dark gray* nodes indicate that a topic is mainly or exclusively influenced by service innovation research, *white* nodes indicate a topic is dominated by service design research, while *light gray* nodes indicate a relationship to both fields. Edges indicate that two connected topics have been investigated together, with thicker edges implying that topic pairs occur together more frequently in the text corpus. Table 4 explains that 72.5% of all edges have a weight of 1, meaning that the two respective topics have been investigated together only once. Figure 2 illustrates the varying edge weights, and Table 5 reports the clustering coefficient of each topic. The average network-clustering coefficient of 36.91%, and network density of 16.28%, indicate that the network service innovation and design research are loose.

Figure 1 shows that service innovation and service design research formed four distinct topic cluster. For one, the service innovation topics Market Orientation (#3), Impact of Service Innovation on Customer Loyalty (#11), and Entrepreneurship (#29) are clustered around Covariance-based Structure Equation Modeling (#43), which further highlights the prevalence of quantitative methods in service innovation research (as indicated in our "Insight 3"). In addition, topics like Knowledge Sourcing for Service Innovation (#14) or Synthesizing Service Innovation Literature (#46) are clustered around Measuring Innovation in Service (#58). Within service design research, Service Encounter (#19) and Service Blueprinting and Modeling (#49) connect all other service design topics. However, this cluster is somewhat disconnected from the core of service innovation research and represents an outlier. Another topic cluster integrates service innovation and service design research around the Healthcare (#31) context, with Coordination of Health Service Networks (#10) or Transformative Service Research (#69) being connected.

Finally, just 15 of 69 research topics are currently investigated by both fields. However, these topics exhibit the strongest positive time trend (see Table 1), which implies that the most prolific topics in the topic landscape (e.g, Designing Service Experiences [#54]) are of interest to both fields. Integrating the less mature but highly dynamic service design with established service innovation knowledge thus represents a promising pathway to stimulate new knowledge. We now delineate an empirically derived research agenda to accomplish this goal.

Table 3. Research Designs Applied in the Service Innovation and Design Topic Landscape.

		Research Design						
Topic Number	Topic Label	Conceptual	Qualitative	Quantitative	Experimental	Modelling + Simulation	Mixed Methods	Herfindahl Index
1	Absorptive Capacity	1	2	4	0	0	0	0.43
2	Dynamic Capabilities and Service Innovation	2	7	1	0	0	1	0.45
3	Market Orientation	0	0	13	0	0	0	1.00
4	Microeconomic Perspectives on Service Innovation	0	1	2	0	3	0	0.39
5	Organizational Capabilities for Service Innovation	5	20	5	0	0	0	0.50
6	SD-Logic	12	13	4	0	0	0	0.39
7	Service Science Lens on Innovation	10	4	3	0	0	0	0.43
8	Adoption of Service Innovation	0	5	17	1	1	1	0.51
9	Business Models	7	6	0	0	0	0	0.50
10	Coordination of Health Service Networks	1	5	2	0	0	0	0.47
11	Impact of Service Innovation on Customer Loyalty	1	0	7	1	0	0	0.63
12	Innovation Practices in the Hotel Industry	3	7	8	0	0	0	0.38
13	Knowledge Sharing and Exchange	0	1	10	0	0	0	0.83
14	Knowledge Sourcing for Service Innovation	1	2	14	0	0	1	0.62
15	Learning from Service Failure	2	2	3	1	0	0	0.28
16	Management Challenges in Service	1	3	7	0	0	0	0.49
17	Managing Service Innovation Projects	0	9	6	0	0	0	0.52
18	Service Architecture and Modularization	2	5	2	1	1	0	0.29
19	Service Encounter	9	4	7	2	1	1	0.26
20	Service Innovation in the Digital Age	12	3	0	0	0	0	0.68
21	Service Innovation through Optimization	1	2	4	1	7	0	0.32
22	Service Process Design	2	10	2	0	0	0	0.55
23	Service System Reforms as Innovations	1	7	3	0	0	0	0.49
24	Servicescapes	3	6	4	1	0	1	0.28
25	Servitization	2	12	5	0	0	0	0.48
26	User Innovation in Service	1	4	6	0	0	0	0.44
27	E-Commerce	4	2	6	0	2	0	0.31
28	Emerging Economies	0	1	5	0	0	0	0.72
29	Entrepreneurship	3	6	9	0	0	0	0.39
30	Financial Services	2	8	5	0	1	0	0.37
31	Healthcare	7	24	11	0	0	0	0.42
32	Hospitality and Tourism	2	3	11	0	1	0	0.47
33	Knowledge-intensive Business Service	0	3	11	0	0	0	0.66
34	Public Service Innovation	5	12	4	1	0	0	0.38
35	Service Innovation in Local Municipalities	1	0	5	0	0	0	0.72
36	Service Innovation in SMEs	1	2	8	0	0	0	0.57
37	Service Innovation in Value Networks	0	10	1	0	0	0	0.83
38	Transportation	0	8	3	0	7	0	0.38
39	Applications of Cluster Analysis	1	3	7	0	0	1	0.42
40	Approaches to identify Causal Relationships	0	2	2	0	1	0	0.36
41	Case Studies	3	6	1	0	0	1	0.39
42	Conjoint and Discrete Choice Analysis	1	1	11	0	2	0	0.56
43	Covariance-based Structural Equation Modeling	0	0	56	2	0	1	0.90
44	Partial Least Squares	0	0	13	0	0	0	1.00
45	Scale Development	0	0	7	0	0	0	1.00

(continued)

Table 3. (continued)

Topic Number	Topic Label	Research Design						
		Conceptual	Qualitative	Quantitative	Experimental	Modelling + Simulation	Mixed Methods	Herfindahl Index
46	Synthesizing Service Innovation Literature	8	8	4	0	1	0	0.33
47	Applying Design Thinking in Service Context	1	3	1	1	1	0	0.27
48	Optimizing Service Attributes	5	5	6	0	3	0	0.26
49	Service Blueprinting and Modeling	11	13	3	0	1	0	0.38
50	Total Quality Management	0	2	14	0	0	0	0.78
51	Comparing Service Innovation by Incumbents and Start-Ups	1	0	17	0	0	1	0.81
52	Cross-Cultural Differences and Service Innovation	5	2	3	0	1	0	0.32
53	Customer Involvement and Relationship Management	1	6	8	2	0	0	0.36
54	Designing Service Experiences	3	16	4	0	0	1	0.49
55	Guiding Service Innovation Research and Practice	11	1	1	0	0	0	0.73
56	Knowledge Management for Service Innovation	1	4	5	0	0	0	0.42
57	Linking Service and Product Innovation	1	1	4	0	0	0	0.50
58	Measuring Innovation in Service	10	1	37	0	0	0	0.64
59	Measuring Service Innovation Performance	2	1	4	0	1	0	0.34
60	New Service Development	2	12	9	0	0	0	0.43
61	Path Dependency in Service Innovation	1	4	0	0	1	0	0.50
62	Planning and Execution of Service Innovation	2	2	3	0	2	0	0.26
63	Sectoral Patterns of Service Innovation	11	3	9	0	1	0	0.37
64	Service Channels	6	0	5	2	0	1	0.34
65	Service Innovation and Firm Performance	2	0	17	0	0	0	0.81
66	Service Innovation and Policy Implications	9	5	7	0	0	0	0.35
67	Service Innovation Competencies	1	2	9	0	0	0	0.60
68	Service Innovation Success Factors	0	2	9	0	0	0	0.70
69	Transformative Service Research	3	7	4	0	0	0	0.38

Notes. $N = 641$. Broken lines indicate the different topic classes.

An Agenda to Integrate Service Innovation and Service Design Research

The intersection of service innovation and service design research remains largely unexplored today (Andreassen et al. 2016). We demonstrated that this research gap persists due to the lack of operationalizable guidelines on *how* to cross-fertilize service innovation with service design research. Our subsequent analysis of the extant literature revealed hidden structures and previously unknown development trajectories, which now enable us to delineate an empirically derived research agenda that aims to foster the cross-fertilization of knowledge across both fields. Table 6 proposes four research directions, which we structure into a set of 12 operationalizable research mechanisms as well as 29 exemplary research questions. Each research mechanism represents a superordinate artifact that can be applied by future researchers to our topic model and data set in order to identify additional research opportunities and questions.

Research Direction 1: Link Disconnected Topics Within the Service Innovation and Service Design Research Network

Our Insight 4 demonstrated that the network of extant service innovation and service design research is only loosely connected. Specificially, only 382 of 2,346 possible topic connections (16.82% overall) have been established by prior research. The most obvious way for future scholars to integrate and cross-fertilize service innovation and service design research is therefore to identify topics in the network that have not been linked by prior research, but have logical connections, and to investigate these in conjunction. We now build upon our Insight 4 and the findings portrayed in Table 1 to delineate three immediately operationalizable research mechanisms that can be applied by future researchers to accomplish this goal. We furthermore demonstrate their applicability through nine exemplary

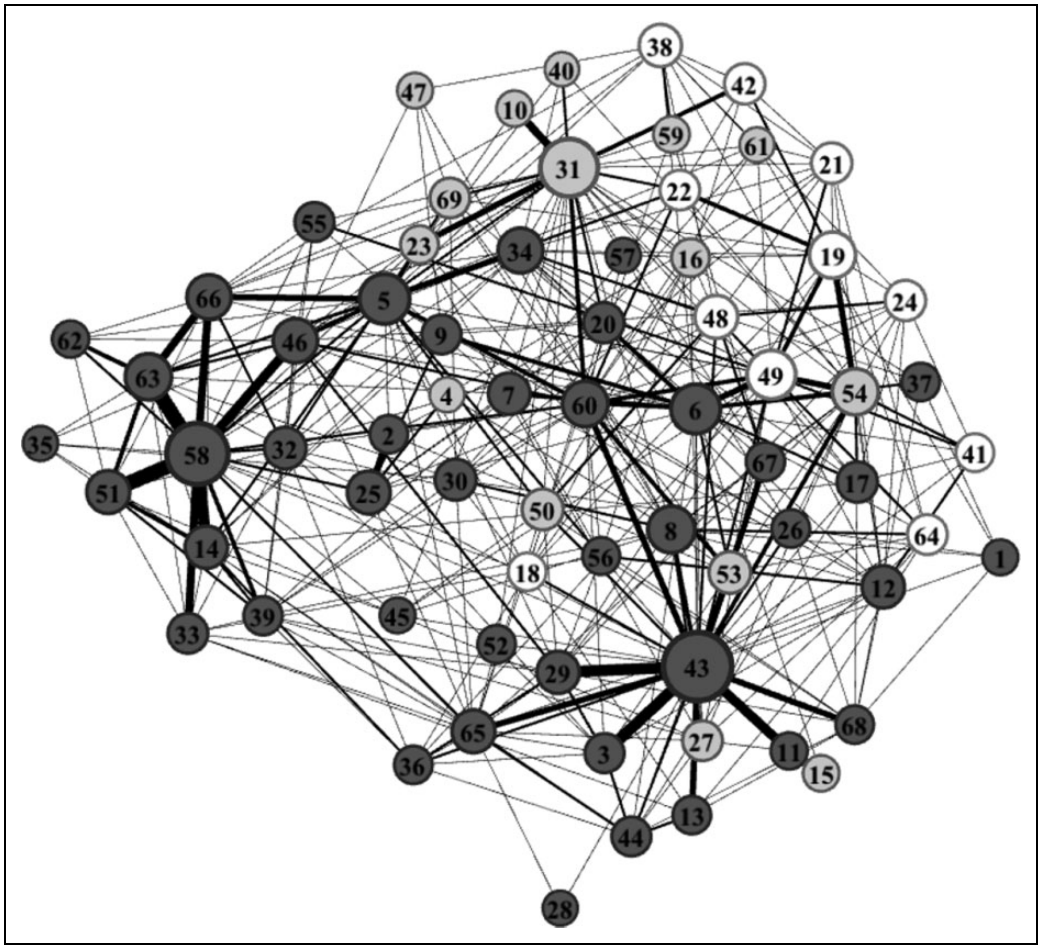

Figure 1. Topic network graph of service innovation and design research.

Table 4. Edge Weights of the Service Innovation and Design Research Topic Network.

Edge Weight	Frequency	%
0	1964	83.72
1	277	11.81
2	62	2.64
3	19	0.81
4	13	0.55
5	4	0.17
6	2	0.09
7	3	0.13
9	2	0.09
Total	2,346	100

research questions that provide tangible pathways to integrate service innovation and service design knowledge across topics.

Mechanism 1.1. We suggest future service researchers *apply theoretical perspectives from the network to explore phenomena that have not been previously studied through these.* This approach would, in turn, also strengthen the rigor of extant research. As a case in point, the topic Dynamic Capabilites and Service Innovation (#2) is a theoretical lens that previously informed service innovation research research on phenomena like Servitization (#25) or Business Models (#9). Moving forward, future research could explore in detail which dynamic capabilities enable organizations to alter their business model, for example, in the context of manufacturing firms developing service solutions (Kowalkowski et al. 2015). Moreover, the topic Dynamic Capabilites and Service Innovation (#2) could also inform future studies about Transformative Service Research (#69), a topic that is of increasing interest to service design scholars (e.g., Anderson et al. 2013). For example, exploring how foreign aid programs might foster the development of dynamic capabilities within developing countries could provide important insights that enable these nations to evolve their economies from low-cost manufacturing to high-value service, thus addressing Fisk et al.'s (2016) call for service design researchers to help alleviate global poverty.

Mechanism 1.2. We propose that *future service researchers link different phenomena within the topic network that have the potential to stimulate new knowledge but have not been investigated together before*. For example, we see a logical but yet

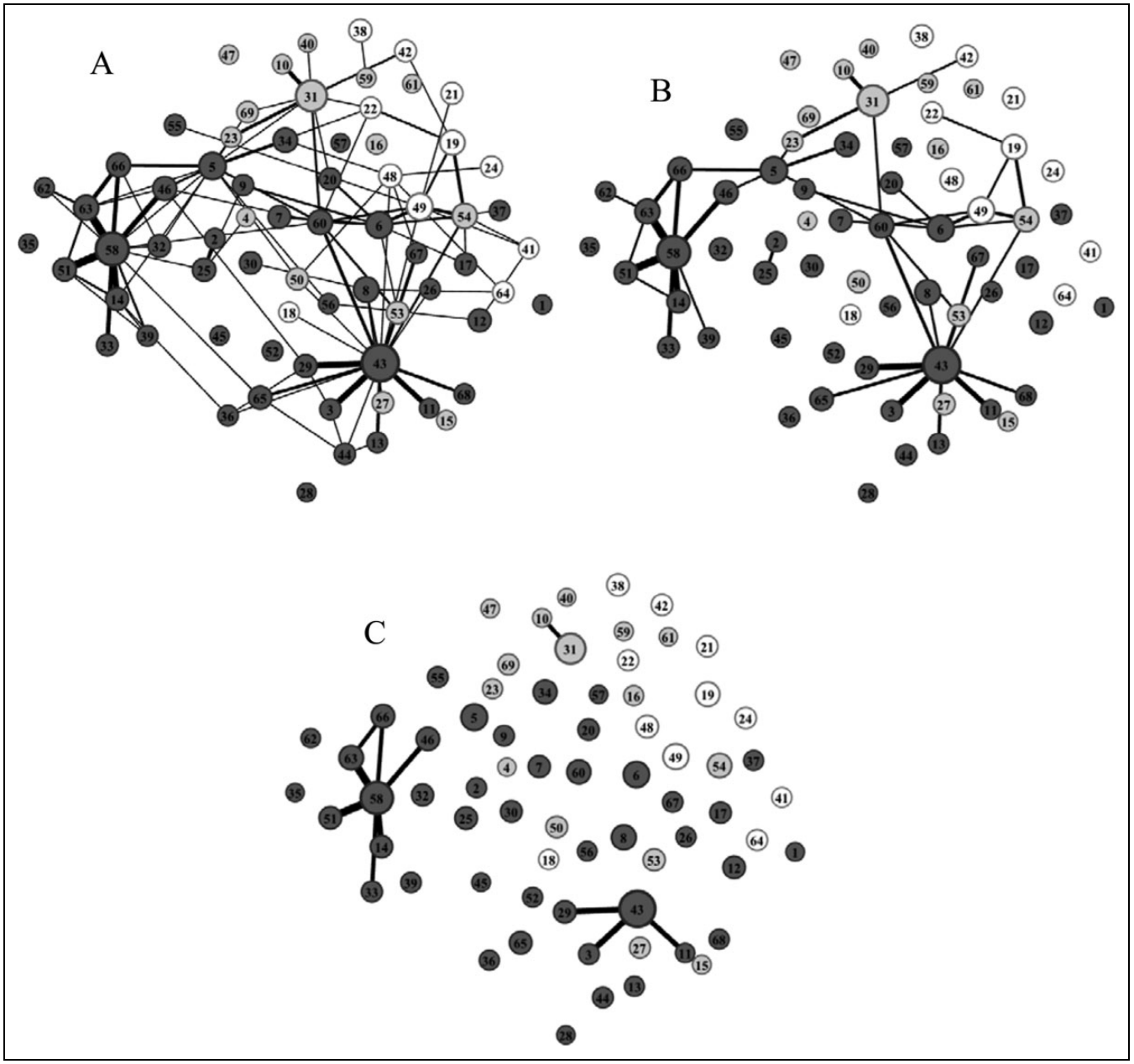

Figure 2. Topic network graphs illustrating the network density. Node numbers refer to the topic numbers as displayed in Table 1. Dark-gray nodes symbolize topics that are mainly or exclusively shaped by *service innovation* research, light gray nodes illustrate topics that are influenced by *both* research fields, and white nodes represent topics dominated *by service design* research. Node size indicates the relevance of the topic in the overall text corpus. Network A hides all edges with weight 1, Network B hides all edges with weights smaller than 3, and Network C hides all edges with weights smaller than 5.

uninvestigated connection between topics such as Service Innovation in the Digital Age (#20) and Knowledge Sourcing for Service Innovation (#14) because it could provide insights into approaches such as crowdsourcing and service platforms (e.g., Lusch and Nambisan 2015). For example, Schäfer et al. (2017) have shown that crowdsourcing platforms such as NineSigma struggle when establishing processes intended to engage their communities. Service design researchers in particular could develop new human-centered service experiences to address this challenge. We also see a connection between the topics Learning from Service Failure (#15) and Business Models (#9). Specifically, linking these could advance knowledge pertaining to the design of new value propositions—a key challenge to service business model innovation (e.g., Maglio and Spohrer 2013). Future empirical studies could explore how service entrepreneurs learn from failure, for instance through ethnographies of so-called "f*ck-up nights," where entrepreneurs publicly discuss and reflect on their business failures. Finally, topics such as Management Challenges in Service (#17) and Knowledge Sharing and Exchange (#13) are

Table 5. Centrality of the Service Innovation and Design Research Topic Network.

Topic Number	Topic Label	Degree Centrality	Degree per Article	Betweenness Centrality	Betweenness per Topic	Clustering
1	Absorptive Capacity	6	0.86	12.90	1.84	0.33
2	Dynamic Capabilities and Service Innovation	6	0.55	6.34	0.58	0.47
3	Market Orientation	10	0.77	17.74	1.36	0.44
4	Microeconomic Perspectives on Service Innovation	4	0.67	4.92	0.82	0.17
5	Organizational Capabilities for Service Innovation	26	0.87	370.55	12.35	0.20
6	SD-Logic	22	0.76	244.70	8.44	0.23
7	Service Science Lens on Innovation	9	0.53	29.59	1.74	0.17
8	Adoption of Service Innovation	19	0.76	186.59	7.46	0.23
9	Business Models	8	0.62	25.34	1.95	0.21
10	Coordination of Health Service Networks	2	0.25	0.00	0.00	1.00
11	Impact of Service Innovation on Customer Loyalty	4	0.44	2.27	0.25	0.67
12	Innovation Practices in the Hotel Industry	17	0.94	109.60	6.09	0.26
13	Knowledge Sharing and Exchange	6	0.55	10.05	0.91	0.40
14	Knowledge Sourcing for Service Innovation	15	0.83	82.92	4.61	0.34
15	Learning from Service Failure	3	0.38	3.01	0.38	0.67
16	Management Challenges in Service	8	0.73	10.21	0.93	0.46
17	Managing Service Innovation Projects	11	0.73	33.34	2.22	0.44
18	Service Architecture and Modularization	10	0.91	46.57	4.23	0.18
19	Service Encounter	13	0.54	53.61	2.23	0.23
20	Service Innovation in the Digital Age	9	0.60	29.69	1.98	0.19
21	Service Innovation through Optimization	12	0.80	55.95	3.73	0.30
22	Service Process Design	7	0.50	12.20	0.87	0.43
23	Service System Reforms as Innovations	6	0.55	8.68	0.79	0.47
24	Servicescapes	11	0.73	25.09	1.67	0.38
25	Servitization	13	0.68	78.68	4.14	0.32
26	User Innovation in Service	8	0.73	25.64	2.33	0.32
27	E-Commerce	12	0.86	51.75	3.70	0.39
28	Emerging Economies	2	0.33	0.00	0.00	1.00
29	Entrepreneurship	14	0.78	72.49	4.03	0.29
30	Financial Services	11	0.69	59.84	3.74	0.13
31	Healthcare	29	0.69	471.65	11.23	0.16
32	Hospitality and Tourism	13	0.76	59.33	3.49	0.27
33	Knowledge-intensive Business Service	10	0.71	34.12	2.44	0.40
34	Public Service Innovation	20	0.91	152.92	6.95	0.26
35	Service Innovation in Local Municipalities	6	1.00	3.93	0.66	0.67
36	Service Innovation in SMEs	10	0.91	15.94	1.45	0.42
37	Service Innovation in Value Networks	5	0.45	10.38	0.94	0.30
38	Transportation	12	0.67	68.25	3.79	0.23
39	Applications of Cluster Analysis	15	1.25	75.12	6.26	0.30
40	Approaches to identify Causal Relationships	4	0.80	0.22	0.04	0.83
41	Case Studies	7	0.64	1.81	0.16	0.81
42	Conjoint and Discrete Choice Analysis	6	0.40	8.73	0.58	0.33
43	Covariance-based Structural Equation Modeling	33	0.56	612.24	10.38	0.20
44	Partial Least Squares	11	0.85	31.27	2.41	0.40
45	Scale Development	9	1.29	26.40	3.77	0.42
46	Synthesizing Service Innovation Literature	18	0.86	151.16	7.20	0.27
47	Applying Design Thinking in Service Context	5	0.71	8.12	1.16	0.20
48	Optimizing Service Attributes	12	0.63	39.85	2.10	0.30
49	Service Blueprinting and Modeling	22	0.79	161.34	5.76	0.31
50	Total Quality Management	10	0.63	27.47	1.72	0.33
51	Comparing Service Innovation by Incumbents and Start-Ups	10	0.53	14.04	0.74	0.53
52	Cross-Cultural Differences and Service Innovation	3	0.27	1.37	0.12	0.33
53	Customer Involvement and Relationship Management	11	0.65	35.35	2.08	0.44
54	Designing Service Experiences	19	0.79	126.64	5.28	0.32
55	Guiding Service Innovation Research and Practice	7	0.54	7.78	0.60	0.38
56	Knowledge Management for Service Innovation	9	0.90	43.60	4.36	0.31
57	Linking Service and Product Innovation	1	0.17	0.00	0.00	0.00

(continued)

Table 5. (continued)

Topic Number	Topic Label	Degree Centrality	Degree per Article	Betweenness Centrality	Betweenness per Topic	Clustering
58	Measuring Innovation in Service	21	0.44	174.76	3.64	0.33
59	Measuring Service Innovation Performance	4	0.50	4.31	0.54	0.17
60	New Service Development	21	0.91	279.36	12.15	0.24
61	Path Dependency in Service Innovation	8	1.33	22.91	3.82	0.43
62	Planning and Execution of Service Innovation	6	0.67	2.69	0.30	0.80
63	Sectoral Patterns of Service Innovation	14	0.58	54.82	2.28	0.37
64	Service Channels	10	0.71	29.12	2.08	0.51
65	Service Innovation and Firm Performance	19	1.00	183.78	9.67	0.25
66	Service Innovation and Policy Implications	13	0.62	53.09	2.53	0.40
67	Service Innovation Competencies	7	0.58	15.07	1.26	0.38
68	Service Innovation Success Factors	11	1.00	40.88	3.72	0.31
69	Transformative Service Research	9	0.64	31.87	2.28	0.22

Notes. $N = 641$. Broken lines indicate the different topic classes.

conceptually linked but have yet to be investigated in conjunction with one another. As a case in point, Antons and Piller (2015) call for future research into how the "not-invented-here syndrome"—a management challenge service firms can experience while incorporating external input during innovation processes that distorts the perception of external knowledge. It would be important to explore how service designers perceive external input into their internal development processes.

Mechanism 1.3. We suggest that the integration of service innovation and service design research can be advanced by explicitly *fostering the inclusion of peripheral topics into the center of the extant research network*. Specifically, our analyses of the network measures in Table 5 and topic network in Figure 1 enable future researchers to identify topics that are somewhat peripheral to existing service innovation and service design research but could consolidate the network. Examples for such peripheral topics include Cross-Cultural Differences and Service Innovation (#52), a topic currently dominated by service innovation research, Service Process Design (#22), a topic currently dominated by service design research, as well as Learning from Service Failure (#15), a topic currently influenced by both fields. Even a topic like Service Innovation in the Digital Age (#20) that is of high academic and managerial relevance at the moment (e.g., Barrett et al. 2015) is only peripheral to the topic network at large. The same is true for other topics that we consider particularly worthy of future research due to their high societal impact (e.g., Emerging Economies [#28] or Transformative Service Research [#69]). We therefore propose that future researchers connect these either to highly central topics or to those exhibiting a strong positive time trend. This is because both, high centrality and positive time trends, indicate a growing interest in these topics within the current service innovation and service design research mainstream, which would enable future researchers to immediately foster the growth of peripheral topics. As a case in point, Impact of Service Innovation on Customer Loyalty (#11) is a periphal topic that is logically connected to Designing Customer Experiences (#54), a topic bridging service innovation and service design, but is also one that exhibits a strong positive time trend. And while prior service design research developed principles and methods intended to support the development of new customer experiences (e.g., Patrício et al. 2011), future research could now apply quantitative methods to test whether the resulting customer experiences enhance relevant outcomes such as customer engagement (e.g., Brodie et al. 2011). Yet another example could be to investigate Learning from Service Failure (#15), a peripheral topic in our network, within Healthcare (#31), a research context that is very central to the topic network, and that has gained a lot of interest from service researchers recently (e.g., Breidbach, Antons, and Salge 2016). Potential research avenues include studies exploring the circumstances under which health-care professionals report errors or near misses so that the organization can learn from these events.

Research Direction 2: Increase the Generalizability of Service Innovation and Service Design Research

Our Insight 1, summarized in Table 1, demonstrated that extant service innovation and service design research has been conducted in 12 different contexts. Furthermore, across the entire body of knowledge, 195 of the 641 articles (approximately 30%) are located in a *single* context only. Moreover, Insight 2 emphasizes that the extent to which service innovation and service design research contributed to each topic varies considerably, and that only service innovation research contributed to every topic to date. Insight 4 revealed that the majority of topics that are linked to one another are connected by a single study only, which emphasizes that our understanding of these topics may be limited and in need of consolidation and refinement but also that the generalizability of findings overall may be limited. As a case in point, Storey et al. (2016) recently attempted to generalize service innovation antecedents through a meta-analysis of 92 independent samples published in 114 different articles. However, all meta-analyses, including the one by Storey et al (2016), are necessarily constrained by the

Table 6. Overview of Research Priorities and Guidelines.

Key Insight(s)	Research Mechanisms	Exemplary Research Questions
Research Direction 1: Link Disconnected Topics within the Service Innovation and Service Design Research Network		
Insight 4	Mechanism 1.1: Apply theoretical perspectives from the network to explore phenomena that have not previously been studied through these.	Which dynamic capabilities enable organizations to alter their business model? How could foreign aid programs foster the development of dynamic capabilities within developing countries? How can state actors help transform service ecosystems by facilitating innovation?
	Mechanism 1.2: Link different phenomena within the topic network that have the potential to stimulate new knowledge, but have not been investigated together before.	How can crowdsourcing intermediaries adapt their processes to facilitate service co-production with the crowd? How do serial service entrepreneurs learn from failure? How do service designers perceive external input into their internal development processes?
	Mechanism 1.3: Foster the inclusion of peripheral topics into the center of the extant research network	Does customer-centric service design enhance customer engagement? Under which circumstances do service frontline employees like healthcare professionals report errors? How can service provider stimulate innovation through recognized errors?
Research Direction 2: Increase the Generalizability of Service Innovation and Service Design Research		
Insight 1 Insight 2 Insight 4	Mechanism 2.1: Identify phenomena that have been investigated within a single context only, and then replicate existing service innovation and service design studies in new contexts.	Are findings replicable and, thus, generalizable across single research contexts?
	Mechanism 2.2: Identify and investigate topics that prior service design contributions have not touched upon at all.	Which contributions from which kind of user to the service design process generate most value?
	Mechanism 2.3: Identify sparsely connected topics, and investigate these in new contexts and combinations.	How do service firms address the challenges associated with emerging technologies? How can new business models ideally be implemented to benefit from technology-enabled value cocreation How should service firms govern knowledge sourcing for innovation purposes?
Research Direction 3: Expand the Theoretical Scope of Service Innovation and Design Research		
Insight 1 Insight 3	Mechanism 3.1: Encourage future service design research to expand its theoretical scope.	How can a service design lens foster a firm's market orientation thereby affecting firm performance? What are the key mechanisms in the service design process that help establishing customer orientation in service innovation? How do service firms transform internal innovation processes while integrating design thinking?
	Mechanism 3.2: Build upon peripheral management theories to inform the current discourse.	Which factors influence customer decisions to adopt new value propositions? Why are employees in service firms reluctant to change? How are service operations affected by new technologies? Why are some service firms more successful in collaborating for service innovation?
Research Direction 4: Advance the Methodological Repertoire of Service Innovation and Service Design Research		
Insight 3	Mechanism 4.1: Adopt previously underutilized methods to investigate existing phenomena or contexts within service design and service innovation research	How does the use of service blueprinting affect firm performance? Do the principles and methods developed for service design practice provide monetary benefits for service firms?
	Mechanism 4.2: Identify topics that have been dominated by quantitative research since their inception, and then use qualitative methods to provide complementary insights	When and under which conditions complements integrating external knowledge into service innovation processes internal research and development processes, and when is it a substitute?
	Mechanism 4.3: Adopt entirely new methods when investigating current and emerging phenomena or contexts	How do implicit attitudes impact new service ideas? How do measures of customer's satisfaction with new value propositions differ when measured explicitly and implicitly?
	Mechanism 4.4: Use entirely new sources of data when investigating current and emerging phenomena or contexts	How can firms integrate customer complaints into service development on a large scale? Which patterns in complaints and their changes predict churn rates? How can firms develop personalized value propositions in a market segment of one?

number of empirical studies available. The number of articles analyzed by Storey et al (2016) for the various effect sizes range from 2 to 31, with only 5 effect sizes being calculated using sample sizes of more than 25 (6.8%) articles. This further demonstrates that the generalizability of current service innovation and service design knowledge should be increased. We now build upon our Insights 1, 2, and 4 to delineate three immediately operationalizable research mechanisms for future researchers aiming to generalize extant service innovation and service design research.

Mechanism 2.1. We suggest future researchers use our topic network to *identify phenomena that have been investigated within a single context only and then replicate existing service innovation and service design studies in new contexts*. Future service research could thereby overcome the concerns regarding the robustness and generalizability of findings beyond single contexts as outlined in our Insights 1, 2, and 4. For example, research about Learning from Service Failure (#15) could be extended into the context of Health care (#31) or Knowledge-intensive Business Services (#33), both of which depend on social capital, and are therefore vulnerable to failure (e.g., Bettencourt et al. 2010). When positioned as replication studies, we encourage future researchers to also replicate research designs and questions.

Mechanism 2.2. The generalizability of service design research could be increased by *identifying and investigating topics that prior contributions have not touched upon at all.* As such, future service design researchers could be the first to explore these topics, while also consolidating their knowledge with prior service innovation research. For example, topics like Impact of Service Innovation on Customer Loyalty (#11), Knowledge Sharing and Exchange (#13), or User Innovation in Service (#26) have only been within the service innovation field to date, and service design studies could contribute further insights through a human-centric perspective that can help better understand customers, contexts, and social practices (Kimbell 2011), as well as interactions and experiences (Zomerdijk and Voss 2010). For example, we see potential for future service design studies to assess the impact that different customer groups have on service design processes. Such insights would be of substantial managerial benefit, because they could inform the selection of appropriate customers as codesigners of new value propositions beyond well-established groups such as lead users (e.g., von Hippel 1986).

Mechanism 2.3. We suggest future researchers use our topic network to *identify sparsely connected topics, and investigate these in new contexts and combinations*. Our analysis of the service innovation and service design topic network indicated that 72.5% of all edges have a weight of one, meaning that the two respective topics have been investigated together in a single study only. This necessarily limits our ability to judge the robustness of effects, their boundary conditions, and the generalizability of findings overall. As a case in point, prior research in the strategic management literature has shown that digitalization affects business model in both product-centric (e.g., Tripsas and Gavetti 2000) and service-centric contexts (Greenstein 2017). However, the link between the topics Business Models (#9) and Service Innovation in the Digital Age (#20) is not understood very well in service research. Future researchers could explore how service firms address the challenges associated with emerging technologies, and how new business models can ideally be implemented to benefit from technology-enabled value cocreation (e.g., Breidbach and Maglio 2016). In addition, a vast body of literature already explored how firms could source knowledge for product innovation projects (e.g., Vega-Jurado, Gutiérrez-Gracia, and Fernández-de-Lucio 2009). In contrast, the service innovation and service design literature appears to be less advanced in this regard, with the topic-pair Managing Service Innovation Projects (#17) and Knowledge Sourcing for Service Innovation (#14) being underinvestigated. Future reseach could investigate how service firms should govern knowledge sourcing for innovation purposes.

Research Direction 3: Expand the Theoretical Scope of Service Innovation and Service Design Research

We have shown through our Insight 1 and Insight 3 that the theoretical foundations of extant service innovation and service design research are limited. Only 7 of the 69 topics (approx imately 10%) are classified as theoretical perspectives, and only 113 of 641 articles (approximately 17%) explicitly rely on any of these (see Table 1). Moreover, our topic network in Figure 1 and findings in Table 5 illustrate that these theoretical perspectives are typically not central to the topic network.[5] And while recent service innovation reviews by Snyder et al. (2016) or Witell et al. (2016) explicitly attempted to advance the theoretical foundations of service innovation research by defining the concept more explicitly, our findings support Biemans, Griffin, and Moenart's (2016) suggestion that the theoretical foundations of service innovation are insufficient. We therefore suggest to advance and integrate extant service innovation and service design research by expanding its theoretical scope and build upon our Insight 1 to delineate two operationalizable research mechanisms that enable future researchers to do so.

Mechanism 3.1. Several of the theoretical perspectives that informed prior service innovation research have not been used by service design to date. We therefore *encourage future service design research to expand its theoretical scope* to close this gap. For instance, none of the 165 articles positioned as servide design contributions to date have used Absorptive Capacity (#1), Dynamic Capabilities (#2), or Market Orientation (#3) as a theoretical perspective. Given that service design is perceived as inherently human-centric in its approach to understanding customers, contexts, and social practices (e.g., Patricio et al. 2011), the absence of Market Orientation (#3) in extant service design research is surprising. Kohli and Jaworski (1990) introduced the concept over two decades ago, and utilizing it within the service design discourse could inform

future inquiries, for example, about how service design practives can foster market orientation, thereby affecting firm performance. Similiarly, Absorptive Capacity (#1) might help understand the diffusion of service design principles across firms, which would explain why some firms introduce design thinking principles into their service innovation processes, while others do not. A Dynamic Capabilities (#2) lens could then explain how service firms transform internal innovation processes while integrating design thinking.

Mechanism 3.2. Our findings have shown that several theories stemming from the wider business and management research have not been used in service innovation and service design reseach to date. We therefore propose that future researchers explicitly *build upon these peripheral management theories to inform the current discourse*. For example, diffusion theory (Rogers 1995) might inform topics such as Adoption of Service Innovation (#8) by explaining which factors influence customer decisions to adopt new value propositions. Similarly, work on structural inertia (Hannan and Freeman 1977) might inform future research aiming to explore changing Business Models (#9) or Servitization (#25), and provide new theoretical insights about why employees in service firms are reluctant to change, how service operations are affected by new technologies, and how practitioners can effectively manage these challenges. Furthermore, firm-level theories like the resource-based view (Barney 1991) and the relational view of the firm (Dyer and Singh 1998) can advance our knowledge of, for instance, Knowledge Sourcing for Service Innovation (#14) and Service Innovation Competencies (#67) by providing insights into why some service firms are more successful in collaborating for service innovation than others and how these processes can be governed.

Research Direction 4: Advance the Methodological Repertoire of Service Innovation and Service Design Research

Wetter-Edman et al. (2014) or Witell et al. (2015) previously suggested that new methods could advance service innovation and service design research. Their work, however, did not specify what methods may be useful nor the means by which new methods could be applied in future service innovation and service design research. Here, we build on our empirical findings to address this gap in knowledge. Specifically, our fourth research direction suggests *how* future service innovation and service design research can be integrated and advanced by extending the methodological repertoire of both fields. Our empirical findings described in Insight 3 demonstrate the methodological maturity of each topic in the research landscape as well as the extent to which quantitative (e.g., structural equation modelling), qualitative (e.g., case studies), or advanced research methods (e.g., simulations) have been used to date. Building upon Insight 3 enables us to delineate four operationalizable research mechanisms.

Mechanism 4.1. We suggest that *future service innovation and service design researchers adopt previously underutilized methods when investigating the 19 phenomena of interest* (e.g., Servitization [#25]) or 12 research contexts (e.g., Health care [#31]) that we identified. Specifically, research on topics such as Service Innovation in the Digital Age (#20) or Path Dependency in Service Innovation (#62) have exclusively used conceptual or qualitative research methods. The same is true for most topics associated with service design research (see also Table 3), including Service Blueprinting and Modeling (#49). Future work should adopt quantitative research designs to investigate these topics, for example, when testing the propositions researchers in this field typically delineate from their qualitative inquieries (e.g., Zommerdijk and Voss, 2010). In addition, our empirical findings indicate that service innovation researchers developed a variety of scales as part of the topic Measuring Innovation in Service (58). This body of knowledge is particularly suitable to investigate topics dominated by service design. A starting point when developing scales could be recent service innovation research on large-scale surveys (e.g., Vergori 2014) or those exploring the role of publicly available data (e.g., Castellacci 2008). By doing so, service scholars will likely be able to answer questions such as: How does the use of service blueprinting affect firm performance or do the principles and methods developed for service design practice (e.g., Zommerdijk and Voss, 2010) provide monetary benefits?

Mechanism 4.2. Future researchers can use our findings to *identify topics that have been dominated by quantitative research since their inception and then use qualitative methods to provide complementary insights*. Specifically, topics associated with service innovation like Knowledge Sharing and Exchange (#13), Comparing Service Innovation by Incumbents and Start-Ups (#51), and Service Innovation and Firm Performance (#65) are some examples. Future qualitative research designs could now use multiple-case studies or ethnographies to generate rich findings that are complimentary to what we already know. As a case in point, the question of whether or not external knowledge is complimentary (e.g., Grimpe and Kaiser 2010), or a substitute (e.g., Hess and Rothaermel 2011), to internal service innovation processes remains unresolved (Gesing et al. 2015). Future qualitative service research could explain when and under which conditions integrating external knowledge into service innovation processes complements internal research and development processes, and when it is a substitute.

Mechanism 4.3. We propose that service innovation and service design researchers *adopt entirely new methods when investigating current and emerging phenomena or contexts*. Our findings indicate that research methods like experiments, mathematical models, simulations, or even mixed method research designs are used by less than 7% of all empirical service innovation and service design studies to date (see Table 2). However, adopting new research methods would enable future researchers to analyze entirely new data sets and, in turn, ask entirely new questions that may generate unprecedented insights. As a case in

point, implicit measures (e.g., Uhlmann et al. 2012) are new research techniques that have been developed to measure constructs human participants cannot control consciously (i.e., latent needs) or whose measurements are affected by biases like social desireability and self-portrayal (i.e., attitudes and stereotypes). Antons et al. (2017) recently showcased the applicability of these techniques for innovation studies. Future service innovation and service design research could provide additional insights into which latent needs drive customer dissatisfaction in service, how implicit attitudes impact new service ideas, and, methodologically, how measures of customer's satisfaction with new value propositions differ when measured explicitly and implicitly?

Mechanism 4.4. Future service innovation and service design researchers should *use entirely new sources of data when investigating current and emerging phenomena or contexts*. The datafication of service is imminent (Rust and Huang 2014), and the data sets service innovation and design researchers face in the future are likely to be different from the ones available today. It will therefore be important to identify which new data sources are available and to master new methods to analyze these. By introducing and demonstrating topic modeling to the discipline, our present study provides service researchers with a blueprint on how to use such a new research method. Specifically, we suggested that the computational algorithms embedded into LDA help overcome the limited human capacity to identify complex relationships in large qualitative data sets. However, our present work represents only the first step, and several future research opportunities emerge from here. For example, understanding the roles customers perform as cocreators of value has been discussed in both service innovation (e.g., Ordanini and Parasuraman 2010) and service design (e.g., Patrício et al. 2011) research. Topic modeling with LDA now provides the means to generated insights about service customers, contexts, providers as well as practices on a large scale; for example, by analyzing transcripts of customer complaint calls or social media postings. Using LDA, future research could predict churn rates, or help develop personalized value propositions in a market segment of one (e.g., Rust and Huang 2014).

Conclusions and Limitations

Our introductory example cited a tale of blind men who believed to understand the "true" appearance of an elephant after exploring different parts of the animal. Prior service innovation research followed a similar trajectory by focusing on contexts like public services (Djellal, Gallouj, and Miles 2013), disciplines like marketing (e.g., Carlborg, Kindström, and Kowalkowski 2014), or by exploring the means service innovation is categorized (e.g., Snyder et al. 2016) and defined (e.g., Witell et al. 2016). However, we now understand that advancing theoretical or normative insights in the field requires us to abandon such singular lenses (e.g., Ostrom et al. 2015) and to broaden the horizon of future service innovation research by integrating insights from service design (e.g., Andreassen et al. 2016). And while calls to cross-fertilize knowledge across both fields repeatedly appeared in the literature to date (e.g., Wetter-Edman et al. 2014; Ostrom et al. 2015; Andreassen et al. 2016), the intersection of service innovation and service design research remained largely unexplored due to the lack of operationalizable guidelines on *how* to accomplish this goal.

Our present work addressed this gap in knowledge. Using a machine learning approach enabled us to analyze the large and heterogeneous body of service innovation and service design knowledge, reveal its hidden structures and gaps between the two fields, and describe previously unknown development trajectories. We do not claim to be the metaphoriocal "sighted men." Instead, our present work aimed to provide the much-needed big-picture overview and reassessment of the field previous service innovation researchers called for (Gallouj and Savona 2009). The research agenda that we put forward here provides tangible guidance to foster the cross-fertilization of service innovation and service design research. Furthermore, we consider it equally important to emphasize that our research questions are examples only, which we delineated to demonstrate the applicability of our research mechanisms. We now encourage future researchers to apply these to the topic model in order to delineate additional research opportunities and questions. As a case in point, the network of extant service innovation and service design research currently includes 69 topics that are linked to each other through 382 topic pairs. However, 1,964 of all possible topic-pairs have not been explored to date. Identifying additional logical connections between previously uninvestigated sets of topics as well as additional research questions and opportunities will enable service researchers to further (1) integrate extant service innovation and service design research across topics, (2) generalize knowledge across, (3) expand the theoretical scope of both fields, and (4) extend the methodological repertoire.

In conclusion, we perceive our study not as an end but rather as a starting point toward a novel line of inquiry that fosters the integration of service innovation and service design research. In particular, we hope that our present work will influence the research tradition in service design, a field where scholars frequently publish their work in outlets such as books (e.g., Osterwalder et al. 2014). These contributions are not included in the data set underpinning out study, and this could explain the relative imbalance of service innovation and service design articles. We therefore encourage future service design researchers to target ISI indexed journals to disseminate their findings, which would also increase the impact of their important contributions to knowledge in the future. And while we provided several research directions for the field, the general evolution of service design research toward more quantitative research (i.e., through quantitative studies of service design practices) that we proposed is of course just one of several alternatives. Current approaches that make use of design science research are equally important and can be further strengthened through insights from our topic model.

Authors' Note

Both authors contributed equally in preparing this manuscript and are listed in alphabetical order.

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Supplemental Material

Supplementary material for this article is available online.

Notes

1. Supplementary Appendix 1 presents an overview and summary of prior service innovation review studies and highlights how we build upon, and extend these earlier contributions.
2. We used Antons, Kleer, and Salge's (2016) 10% cutoff value to identify if individual topics were relevant to either service innovation or design research or if their relevance varied across our text corpus.
3. To provide face validity of our approach, Supplementary Appendix 2 illustrates the results of the LDA algorithm for five prominent service innovation and service design articles.
4. We used the following rationale to define whether a topic is dominated by service innovation, service design research, or both domains: In case the Herfindahl Index exhibits a value of equal or more than 0.6, we interpretate a topic as concentrated. Using the number of articles, we then identified which domain (service innovation or service design) dominated each concentrated topic.
5. Notable exceptions are Organizational Capabilities for Service Innovation (#5) with a degree centrality of 26 and SD-Logic (#6) with a degree centrality of 22. Both theoretical perspectives informed more than 20 different studies.

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