Unblackboxing Digital Services – Spotlight on Data and Interaction

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‘When the wind of change blows,
some build walls, while others build windmills.’

(Chinese Proverb)

Für meine Familie Martina, Walter und Jessica.

Spezieller Dank an meine Mentoren Max und Henner
sowie alle Wegbegleiterinnen und Wegbegleiter während meiner Promotion.

Abstract

Digitalization describes sociotechnical phenomena at individual, organizational, and societal levels. It is fueled by digital technologies that impact the collection and analysis of data and how we interact. Digital technologies enable new business models, innovative products, and digital services. Despite its rapid progress in practice, there are only few theoretical insights on digital services. Hence, there is a need to conduct research to gain understanding of the multitude of novel phenomena in the context of digital services. Against this backdrop, this cumulative doctoral thesis aims to "unblackbox" digital services, consider their specifics regarding data and interaction, and understand their application in selected industries. This is complemented by an in-depth examination of taxonomy design as a method to analyze emerging phenomena such as digital services.

Considering the perspectives data and interaction, this doctoral thesis first analyzes privacy and proactivity as two cross-industry phenomena in the context of digital services. The emergence of new data sources (e.g., sensors of smart things) and advanced data processing algorithms (e.g., Artificial Intelligence) has not only contributed to an increase in the value, velocity, and volume of data but has also underlined the need to protect privacy. Despite the prevailing opinion of data privacy as a necessary evil, the research article #1 takes an upside perspective on data privacy. Based on the well-established Kano model, the article empirically shows that the implementation of certain data privacy measures has the potential to delight consumers and may thus form the basis for building customer trust and sustaining competitive advantage. The privacy-aware analysis of consumers' personal and contextual data, for instance, can help organizations to anticipate consumer needs. On this basis, digital services facilitate proactive interaction between the organization and consumers or on behalf of consumers. For instance, a smart washing machine automatically reorders detergent based on the anticipated demand. The research article #2 analyzes such proactive digital services through the empirical and conceptual design of a taxonomy; the article also applies the taxonomy on exemplary proactive services and evaluates it through expert interviews.

After examining the two cross-industry phenomena of privacy and proactivity, we investigate the application of digital services in two selected industries. The Internet of Things (IoT) has facilitated connectivity between devices with sensors and actuators (e.g., speakers and washing machines) and the Internet. In retail commerce, this connectivity has led to novel ways of how products and services can be ordered online. The research article #3 refers to this phenomenon of "IoT-commerce" and charts its evolution from traditional to electronic and mobile commerce. Building on the methodological foundation of the activity and affordance theories and supported by literature review and empirical validation, this article proposes opportunities of IoT-commerce for consumers (i.e., affordances) and its manifestations along the consumer buying process. This thesis also sheds light on digital services offered by fintech start-ups (integration of financial services and information technology). Using digital technologies such as Artificial Intelligence and Blockchain, fintech start-ups spearhead digital innovation in the financial services industry and offer enhanced and new value propositions for consumers (e.g., crowdlending and cryptocurrencies). In particular, the research article #4 analyzes the service offerings of fintech start-ups from a non-functional perspective. For this purpose, the article proposes a conceptual and empirical taxonomy that is applied to a sample of 227 real-world fintech start-ups and used to derive archetypes with statistical cluster analysis.

All related research articles analyze novel phenomena with hitherto little theoretical knowledge. In this regard, it must be noted that, as theories for analyzing, taxonomies help in understanding emerging phenomena such as digital services. Rapid technological progress has also increased the relevance of taxonomies for current and future research. However, a structured assessment of the recent taxonomy research reveals an ambiguity pertaining to the operationalization of the taxonomy design and the evaluation of the taxonomies. Hence, while research articles #2 and #4 employ taxonomies to conceptualize phenomena based on the classification of real-world objects, the research article #5 concludes this doctoral thesis with a methodological contribution. This article proposes an extended taxonomy design process that includes evaluation and provides operational recommendations for taxonomy designers.

In conclusion, this cumulative doctoral thesis conceptualizes digital services through different theoretical lenses. In this regard, the research articles use both qualitative and quantitative research methods (e.g., Kano model, taxonomy design, statistical cluster analysis), build upon well-established theoretical foundations (e.g., activity and affordance theories), and incorporate different forms of empirical evidence (i.e., primary and secondary data sources).

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I. Introduction[1]

Digital services are becoming an integral part of our everyday life. Earlier, a physical visit to a brick-and-mortar store was critical to procuring items of daily necessities; however, the Internet has eliminated such spatial and temporal restrictions, facilitating the remote procurement of a broad range of services. This shift towards digital services does not represent an improvisation of an existing concept, given that this transition leads to a complete transformation of business processes. These digital serve as the basis for new and disruptive business models across industry boundaries and enhance existing value propositions. For example, the ability to book flights online via smartphone applications at any time and from anywhere has enhanced the convenience and price transparency of flight tickets, thereby impacting the entire ticketing market. Price comparison, as a digital service, served as the underlying idea for disruptive business models of cross-industry platforms such as CHECK24; these platforms offer price comparisons in the areas of automobile insurance tariffs, flight tickets, and Zumba fitness classes, among others. Given their functions, these platforms dominate the interface with consumers; hence, they are critical to companies' long-term success (Gimpel et al., 2018). Against this backdrop, it has become increasingly important to 'unblackbox' digital services to achieve a detailed understanding of their specifics.

Digital services are services "obtained and/or arranged through a digital transaction (information, software modules, or consumer goods) over Internet Protocol (IP)" (Williams, Chatterjee, & Rossi, 2008, p. 506). These digital transactions are shaped by digital technologies. More specifically, digital technologies refer to the creation, processing, transmission, and use of digital goods summarized under the terms information, communication, and media (Berger, Denner, & Röglinger, 2018). The digital technologies not only comprise established technologies (e.g., mobile and social media) but also emerging technologies such as the Internet of Things (IoT) and Artificial Intelligence (AI). Berger et al. (2018) grouped digital technologies into the following seven clusters: (1) *platform*, (2) *connectivity*, (3) *actor-based product*, (4) *sensor-based data collection*, (5) *analytical insight generation*, (6) *analytical interaction*, and (7) *augmented interaction*. To develop their taxonomic classification, Berger et al. (2018) built on the four layers of digital technologies, as introduced by Yoo, Henfridsson, and Lyytinen (2010): (1) *device*, (2) *network*, (3) *service*, and (4) *contents*. On a generic level, Yoo et al. (2010) differentiate digital technologies from earlier technologies on the basis of the following three key characteristics: (1) *reprogrammability* that separates functional logic of a device from its physical embodiment, (2) the *homogenization of data* to store, transmit, process, and display digital contents using the same digital devices, and (3) the *self-referential nature* of digital technologies that fuels their creation and availability through positive network externalities.

[1] This section partly comprises content from this thesis' research articles. To improve the readability of the text, I omitted the standard labelling of these citations.

These digital technologies accelerate the advancement of the nature and delivery of digital services. For consumers and organizations alike, these advancements in digital services are accompanied by changes and chances. In this context, it must be noted that organizations across industries are confronted with the disruption of established business rules in the digital and the physical enivironment (Gimpel et al., 2018). Some of these disruptions occurred when Airbnb evolved to become the world's largest accommodation provider without owning real estate; online price comparison of flights stirred up the entire airline ticketing industry; cryptocurrencies, such as Bitcoin, challenged the raison d'être of banks as financial intermediaries. To keep pace and succeed in a digital world, organizations must excel in six fields of action as detailed by Gimpel et al. (2018): (1) *customer*, (2) *value proposition*, (3) *data*, (4) *operations*, (5) *organization*, and (6) *transformation management*. However, digital technologies hold unique opportunities for organizations. The digital data of these digital services can be "combined easily with other digital data to deliver diverse services, which dissolves product and industry boundaries" (Yoo et al., 2010, p. 726). In other words, the collection and analysis of various personal and contextual data allow for (new) value-adding digital services.

When using a digital service, consumers provide personal data either explicitly (i.e., data inputs by the consumer) or implicitly (i.e., analysis of the consumer's behavior). Given the integration of physical products and things with sensors and actuators, organizations can merge the personal consumer and contextual data derived from these so-called "smart things" with publicly available "open data". In this way, they can exploit existing opportunities to enhance service offerings (e.g., with personalized recommendations) or target consumers with completely new value propositions. However, these significant volumes of data also provide a target for attack. Recently, the social media platform Twitter suffered a data breach compromising several user accounts, including those of Apple, Barack Obama, and Elon Musk (BBC, 2020). The hacker attack resulted in a cryptocurrency fraud of more than 100,000 USD. Besides data security, data privacy also contributes to the financial and reputational risks of companies. Apple was accused of collecting and storing location data of iPhones without their users' consent (Arthur, 2011) and Facebook was found to sell personal data of its users to advertising companies (Beaumont, 2010). The European Union's General Data Protection Regulation (EU-GDPR), which went into effect in May 2018, established clear and restrictive rules for the processing of personal data of European consumers (GDPR.EU, 2020). This regulation strengthened the digital integrity and sovereignty of European consumers. However, organizations have been reportedly struggling to comply with this binding regulation, which often demands substantial investments into suitable privacy measures (Mikkelsen, Soller, & Strandell-Jansson, 2017). Hence, data privacy is considered a necessary evil by organizations striving to enter or operate in the European market. This thesis' research article #1 sheds light on the upside of data privacy, showcasing it as a vehicle for organizations to delight consumers, earn their trust and sustain competitive advantage.

In an IoT system, sensors collect data from the surrounding environment, which can be used by companies for digital services in accordance with the data protection regulations. From a technical lens, the IoT is a global network of things that are interconnected on the basis of standard communication protocols and are uniquely addressable (Atzori, Iera, & Morabito, 2010). A broader definition describes IoT as “the connectivity of physical objects equipped with sensors and actuators to the Internet via data communication technology” (Oberländer, Röglinger, Rosemann, & Kees, 2018, p. 488). These physical boundary objects between the physical and digital worlds are referred to as “smart things”. In the business-to-consumer context, smart things comprise smartphones, smartwatches, smart home appliances (e.g., thermostats, speakers, and light bulbs), and large consumer goods such as cars and washing machines. From a socio-material perspective, smart things, with their independent agency, can be seen as the autonomous interaction partners of the networked society, given their role in extending business-to-consumer interactions (Oberländer et al., 2018). The thing-centered interaction may occur when a consumer interacts with a business through a smart thing. For example, it occurs when a consumer uses the touchscreen display of the smart fridge to place an online order for groceries. A smart fridge knows its contents and its touchscreen display allows consumers to order groceries online; hence, this gadget is considered a prototypical example of IoT applications (Evans, 2017). The application of IoT in retail commerce might even be “the most profound shift ushered in by the IoT era” (Evans, 2018, p. 1). Other real-world applications include Amazon’s smart speaker that allows online order placements via voice command and the smart washing machines from Whirlpool and GE Appliances that replenish detergent autonomously based on consumption and anticipated demand. This thesis’ research article #3 coins this phenomenon of purchasing products and services online via smart things as “IoT-commerce” and investigates the specific affordances that IoT-commerce provides as opportunities to consumers.

As introduced in research article #3, on affordance of IoT-commerce is the automation of consumer processes. Based on the collection and analysis of personal and contextual data, the whole buying process or parts of it (e.g., ordering and payment) are conducted automatically by a digital service; these operations are based on algorithmic decision-making and require minimal or no active involvement of the consumer. For instance, a smart washing machine automatically orders detergent from an online retail marketplace based on the stock level and anticipated consumption. Such proactive digital services can also be seen in several industries besides retail commerce. This thesis’ research article #2 presents several examples of such proactive digital services across industries and investigates their specific characteristics; it analyzes these services through the development, application, and evaluation of a taxonomy. Concerning the research article’s taxonomy, for instance, proactive digital services differ in terms of the *consumer relief*. A proactive digital service might relieve the consumer from the *consideration* phase of the buying process by recommending personalized products. After the consumer decides to purchase the recommended product, the proactive digital service might not only relieve the consumer from the *consideration* phase but also from the *enactment* phase. Ultimately, the proactive digital service might act autonomously while relieving the consumer from the purchase *decision* itself.

Digital services evolve in various industries besides the retail commerce industry. In the financial services industry, the fintech phenomenon represents the integration of digital technologies with innovative value propositions and disruptive business models based on them. In other words, fintech is the abbreviation of “financial technology” (Cambridge Dictionary, 2020). Thereby, fintech does not refer to traditional core banking IT systems, but it refers to the use of emerging digital technologies such as blockchain, machine learning, and mobile computing. For instance, N26, a fintech unicorn, launched a free online bank account that consumers can open from their mobile device within 8 minutes. Besides others, the domains of fintech include crowdfunding platforms, cryptocurrency marketplaces, mobile payment, and digital insurances. From a non-functional perspective, using a taxonomy, this thesis’ research article #4 characterizes the service offerings of consumer-oriented fintech start-ups in relation to interaction, data, and monetization and thereby contributes to the understanding of digital services in the financial services industry.

In sum, the overarching research aim of this thesis is to ‘unblackbox’ digital services, particularly consider specifics regarding data and interaction, and understand their application across industries. Owing to its novel perspectives on digital services, this doctoral thesis is relevant to both researchers and practitioners. It is a cumulative doctoral thesis and consists of five research articles. The articles contribute to the research aim by applying different conceptual and theoretical lenses, showing different forms of empirical evidence, using qualitative and quantitative research methods, and offering varying levels of granularity. This thesis is complemented with a detailed analysis of taxonomy design in the domain of Information Systems (IS). This thesis has focused on taxonomies as they provide a unique opportunity to analyze novel phenomena such as digital services. Based on this context, the research articles of this doctoral thesis are assigned to one of the three topics outlined in Figure 1: *Privacy and Proactivity as Cross-Industry Concepts*, *Retail Commerce and Financial Services as Selected Industries*, and *Taxonomy Research in Information Systems as Method Deep-Dive*.

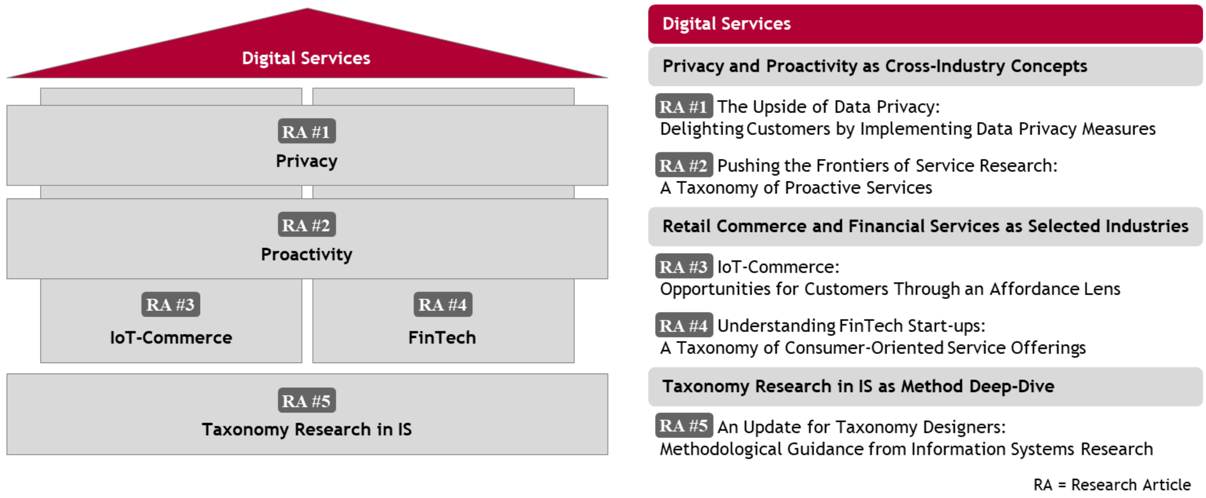

Figure 1: Assignment of the research articles to the topics structuring this doctoral thesis

The first topic (Section II.1) of this doctoral thesis introduces privacy and proactivity as the two major concepts affecting digital services across industries. Thus, the research article #1 focuses on the upside of data privacy and how organizations can implement specific data privacy measures to delight consumers and escape from data privacy as a necessary evil. The research article #2 pushes the frontiers of service research and analyzes proactive digital services through the development of a taxonomy, its application, and evaluation. The second topic (Section II.2) of this doctoral thesis investigates digital services in two industries. Based on this focus, the research article #3 highlights the use of smart things for providing digital retail services. It refers to this phenomenon as IoT-commerce and presents affordances as opportunities for IoT-commerce consumers. The research article #4 is concerned with digital services in the financial services industry. From a non-functional perspective, using a taxonomy, the article analyzes the service offerings of consumer-oriented fintech start-ups. The final topic (Section II.3) provides a detailed analysis of taxonomy design used as a methodological foundation in two of this thesis' five research articles (#2 and #4). In this context, the research article #5 presents the results of the analysis of recent taxonomic publications. To bridge the shortcomings of extant methodological guidance, the article proposes an extended taxonomy design process and operational recommendations.

Subsequently, Section III summarizes this doctoral thesis and discusses the scope for future research. Section IV lists the publication bibliography. Section V presents an appendix comprising an index of the research articles (Section V.1), details on my contribution to each research article (Section V.2), and the research articles themselves (V.3-V.7).

II. Overview and Research Context[2]

1 Privacy and Proactivity as Cross-Industry Concepts

Organizations analyze consumer data comprising consumers' preferences, goals, and behaviors, in order to enhance extant and develop new value propositions to sustain competitive advantage (Morey, Forbath, & Schoop, 2015). As part of an IoT system, smart things as interconnected physical objects and potentially autonomous actors provide organizations with access to novel data sources. Such data allows organizations to interact with and on behalf of the consumer proactively. However, during the collection, processing, and storage the personal and contextual data become vulnerable to hacker attacks. Thus, organizations focus on suitable data security and data privacy measures to prevent data breaches and the misuse of consumer data. In the European market, the General Data Protection Regulation (EU-GDPR) introduced binding data security and privacy standards to restore and strengthen the digital integrity and sovereignty of European consumers. As the implementation of this regulation entails substantial investments, many organizations see data privacy as a necessary evil and include it in their risk management plans (Mikkelsen et al., 2017). From an economic perspective, some authors even state that data privacy measures should only be implemented if the risk-reducing effects outweigh the related costs (Buhl, 2013). However, integrated management of data privacy requires the consideration of an upside perspective.

The research article #1 takes this upside perspective on data privacy. It addresses the following two-fold research question: Which data privacy measures can be implemented by companies? Do consumers consider some of these measures attractive and delightful? To answer these research questions, the article combines inductive and deductive approaches. First, the authors compiled a list of data privacy measures on the basis of a structured literature review and legislative texts (i.e., deductive approaches) as well as organizations' privacy statements and expert interviews (i.e., inductive approaches). They considered the academic literature, the extensive legislative texts of the EU-GDPR, and the Germany-specific *Bundesdatenschutzgesetz* (BDSG) and *Telemediengesetz* (TMG). Further measures were extracted from nine exemplary data privacy statements of organizations in various industries known for extensive data analysis or a strong obligation to data protection. The authors also interviewed three experts – a data privacy officer of a German automotive company, a researcher involved in the development of a data privacy strategy for a large bank, and a lawyer with expertise in European privacy laws. From all four sources, the authors collected, examined, and grouped 202 statements by semantic similarity. Each statement considered certain aspects of a potential data privacy measure. This procedure resulted in 32 groups of statements; of these groups, the authors each derived a data privacy measure considering all statements of the group. Considered the first and most influential work on privacy concerns, Smith, Milberg, and & Burke (1996) explored seven major data privacy concerns of consumers: (1) *data collection*

[2] This section partly comprises content from this thesis' research articles. To improve the readability of the text, I omitted the standard labelling of these citations.

(storing large amounts of personal consumer data), (2) *data combination* (combining of consumer data from various databases to gain additional consumer information), (3) *internal secondary usage* (using consumer data for an unauthorized secondary purpose within the company), (4) *external secondary usage* (disclosing consumer data for an unauthorized secondary purpose outside the company), (5) *errors* (committing deliberate or accidental errors in customer data), (6) *improper access* (illegally viewing and editing consumer data), and (7) *reduced judgment* (automating decision-making based on customer data). The authors mapped all 32 data privacy measures to one or more of these data privacy concerns. Table 1 shows an excerpt and outlines the identified data privacy measures addressing the concern 'data collection'.

#	*Detailed description*	*Reference(s)*
A	**Data Collection**	
A1	**Information.** The purpose, scope, and storage time of the data collection and the involved advantages, risks, resulting rights, and obligations are clearly explained to the customer.	§33 (1) BDSG; §13 (1) TMG; 5 (1.a), 12 (1), 14 (1), 15 EU-GDPR, Facebook (2017), Telekom DE-Mail (2017), Tesla Motors (2017), Zalando (2017)
A2	**Anonymization.** Customer data are, as good as is possible, stored anonymously to prevent backtracking of individual customers.	§3a BDSG; §13 (6) TMG; 23, 30 (1), 30 (1.a), 30 (2.b) EU-GDPR, Apple (2017), Deutsche Bank (2017)
A3	**Restraint.** Only the customer data absolutely necessary to provide the agreed service are collected. The data are deleted as soon as the purpose of their collection no longer applies.	§3a BDSG; §14 (1), §15 (1) TMG; 5 (1.b), 5 (1.c), 23 EU-GDPR, Deutsche Bank (2017), Dropbox (2017), Facebook (2017)
A4	**Empowerment.** The customer can extend, limit or revoke the permission to store and use his data easily, quickly, free of charge and at any time.	6 (1.a), 6 (1.b), 7 (3), 12 (1.a), 17, 17a, 19 (1) EU-GDPR, Amazon (2017), Apple (2017), Deutsche Bank (2017), Tesla Motors (2017), Zalando (2017)
A5	**Data release.** At the request of the customer and without a long delay, the company provides a set of his personal data free of charge in an easily readable form. Furthermore, the customer has the right to pass these data on to other companies.	12 (1.a), 12 (2), 12 (4), 18 (2) EU-GDPR, Deutsche Bank (2017), easyJet (2017), Facebook (2017), Telekom DE-Mail (2017), Zalando (2017)

Table 1: Excerpt of data privacy measures addressing the first of the seven privacy concerns as identified by research article #1

The authors utilized the Kano model in two empirical studies to explore the consumers' view of the identified data privacy measures. The Kano model describes consumer satisfaction depending on the degree of implementation or the availability of certain product/service attributes (Kano, Seraku, Takahashi, & Tsuji, 1984; Matzler, Hinterhuber, Bailom, & Sauerwein, 1996). Applied to the context of data privacy, the Kano model explicates consumer satisfaction as a proxy for sustainable and profitable consumer relationships depending on the (non-)implementation of particular data privacy measures and in relation to the consumer's expectations. Thereby, a data privacy measure can be perceived as one of four factors, as shown in Table 2.

Factor	*Customers' expectations*	*Effect on satisfaction*	
		if implemented	*if not implemented*
Attractive quality (delighter)	Customers do not expect implementation of measure	positive	none
One-dimensional quality (performance need)	Customers explicitly demand implementation of measure	positive	negative
Must-be quality (basic need)	Customers implicitly demand implementation of measure	none	negative
Indifferent quality	Customers are indifferent to implementation of measure	none	none

Table 2: List of the Kano model factors as described by Matzler et al. (1996) and applied to the data privacy context by research article #1

Data privacy measures classified as must-be qualities are those typically referred to as a necessary evil. They will not increase consumer satisfaction if implemented but will increase the risk of consumer dissatisfaction if not implemented. Data privacy measures classified as performance needs have a direct impact on consumer (dis-)satisfaction – both when implemented (satisfaction) and not (dissatisfaction). From an upside perspective on data privacy, most relevant measures are classified as attractive qualities. They represent delighters that have a substantial positive impact on consumer satisfaction but do not lead to any dissatisfaction if they are not implemented as these measures are not expected by consumers. To capture the actual evaluation of the data privacy measures, the research article #1 presents the results of two consumer surveys that successfully passed a pre-test. The first and second survey comprise a real-world scenario from the airline industry (i.e., online flight booking) and from retail commerce (i.e., online purchase of products), respectively. Several hundred consumers participated in the surveys, which yielded mainly consistent results. Table 3 outlines the assignment of all identified data privacy measures to their respective Kano model factors.

#	Short description	Aviation survey (n = 219)		Retail survey (n = 270)		
		Category strength	*Categorization*	*Category strength*	*Categorization*	*Accordance*
A	**Data Collection**					
A1	Information	21% *	M	30% *	M	yes
A2	Anonymization	10% *	A	11% *	A	yes
A3	Restraint	12% *	M	3% [2]	Mixed (O, A, M)	partially
A4	Empowerment	18% *	M	3% [2]	Mixed (M, A, O)	partially
A5	Data release[3]	4% [2]	Mixed (M, A, O)	3% [1]	A	partially
B	**Data Combination**					
B1	Information	11% *	I	4% [1]	M	no
B2	Anonymization	8% *	M	11% *	M	yes
B3	Restraint	18% *	I	30% *	I	yes
B4	Empowerment	13% *	A	14% *	A	yes
C	**Internal Secondary Usage**					
C1	Information	21% *	M	20% *	M	yes
C2	Deletion	20% *	M	21% *	M	yes
C3	Tracking	17% *	A	4% [2]	Mixed (A, O, I, M)	partially
C4	Restraint	16% *	A	23% *	I	no
C5	Empowerment	13% *	A	13% *	A	yes
D	**External Secondary Usage**					
D1	Information	49% *	M	46% *	M	yes
D2	Guidelines	58% *	M	45% *	M	yes
D3	Compliance check	17% *	M	22% *	M	yes
D4	Codification	4% [2]	Mixed (M, A, I)	3% [1]	M	partially
D5	Anonymization	34% *	M	24% *	M	yes
D6	Restraint	1% [2]	Mixed (A, O)	6% [2]	Mixed (A, O)	yes
D7	Empowerment	14% *	M	8% *	M	yes
E	**Errors**					
E1	Reviews	60% *	I	64% *	I	yes
E2	Protective measures	49% *	I	32% *	I	yes
E3	Employee supervision	37% *	M	40% *	M	yes
E4	Tracking	4% [1]	A	1% [2]	Mixed (M, A, O, I)	partially
E5	Empowerment	11% *	M	13% *	M	yes
F	**Improper Access**					
F1	Information	42% *	M	43% *	M	yes
F2	Protective measures	40% *	M	44% *	M	yes
F3	Secure server location	4% [1]	A	4% [1]	A	yes
G	**Reduced Judgment**					
G1	Information	11% *	I	17% *	I	yes
G2	Reviews	4% [1]	M	4% [1]	M	yes
G3	Restraint	1% [1]	M	10% *	M	yes

Legend:
** = Categorization significant at a five-percent level according to Fong test*
[1] = (O + A + M) < > (I + R + Q) rule applicable
[2] = (O + A + M) < > (I + R + Q) rule not applicable
A = Attractive quality (delighter)
O = One-dimensional quality (performance need)
M = Must-be quality (basic need)
I = Indifferent quality

Table 3: Empirical results of the data privacy measures' evaluation in research article #1

Unsurprisingly, 17 out of 32 data privacy measures were classified as basic needs (*must-be qualities*) in each survey. Hence, the implementation of these measures is not rewarded by consumers and can be considered as a necessary evil, for instance, when complying with binding legislation. However, seven

[3] Owing to technical complications in revising and providing the retail survey online, the questions on the measure A5 were answered by 143 instead of 270 participants.

(*aviation*) respectively five (*retail*) data privacy measures were evaluated as delighters (*attractive qualities*) by the consumers. For instance, consumers were delighted if the servers of a digital service were located in the European Union (*measure F3*) or if they could easily decide which of their personal data are shared for other purposes and with other departments of the provider of a digital service (*measure C5*). This implies that data privacy and the implementation of measures should not only be seen from a risk-minimizing downside perspective, but also from a consumer-oriented upside perspective that entails the opportunity to delight consumers and enables organizations across industries to differentiate with a competitive advantage.

As another cross-industry concept, the research article #2 analyzes proactivity in the context of digital services. Novel data sources (e.g., sensor data from smart things) and sophisticated ways of analyzing structured and unstructured data (e.g., with AI) provide organizations the tools to understand their consumers more comprehensively. Earlier, organizations mainly leveraged internal data for their commercial benefit; however, nowadays consumers are increasingly willing to disclose personal data to receive value-adding digital services in return (Froehle & Roth, 2004; Kowalkiewicz, Rosemann, Reeve, Townson, & Briggs, 2016). This scenario has fueled a technology- and data-driven paradigm shift toward organizations providing highly personalized digital services addressing consumer needs even before the consumers demand it (Dauda & Lee, 2015).

With their push-rationale, proactive digital services have been pushing the frontiers of service research. In other words, proactive digital services no longer wait for the consumers' inquiries but make the first move in consumer interactions (Leyer, Tate, Bär, Kowalkiewicz, & Rosemann, 2017). Thus, personalized and proactive interactions are based on anticipated needs concluded from a comprehensive consumer profile including goals, preferences, and behaviors. In the business-to-business context, such proactive digital services are known under the umbrella term 'predictive maintenance' where they are employed to determine proactively when maintenance should be performed based on the actual machine condition and historic data in order to minimize downtimes (Wang, Chu, & Wu, 2007). These proactive digital services also employed in the business-to-consumer contexts. Real-world examples manifest with different maturity levels: from simple recommendations (e.g., personalized insurance tariff recommendation by CHECK24) to advanced assistants (e.g., Google Assistant with proactive task recommendation and execution) to fully autonomous agents (e.g., autonomous replenishment of detergent in washing machines of GE Appliances). Despite their rising relevance in our everyday life, the literature on proactive digital services lacks theoretical depth. First publications deal with a model for proactive mobile recommendations (Woerndl, Huebner, Bader, & Gallego-Vico, 2011), overarching specifics of proactive organizations (Kowalkiewicz et al., 2016), and the acceptance of proactive digital services (Leyer et al., 2017). However, a comprehensive analysis of the characteristics of proactive digital services is missing.

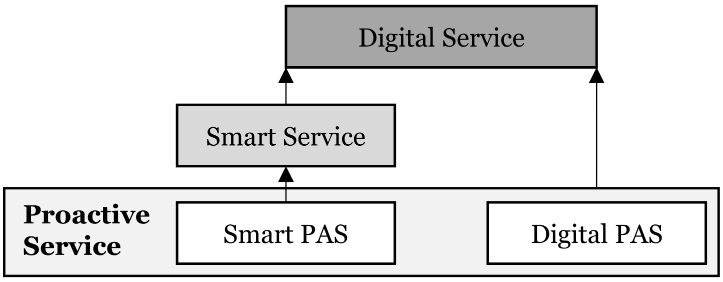

Figure 2: Inheritance relationship between digital, smart, and proactive services (i.e., PAS) as introduced in research article #2

As outlined in Figure 2, proactive services are related to smart and digital services. In digital services, consumers cannot participate unaided by IT as digital services entail digital interactions over the Internet (Williams, 2008). These digital services may comprise physical aspects (e.g., physical delivery of a parcel after ordering online), but they are primarily characterized by digital properties as they exclusively exist and operate in a digital environment such as the Internet (Beverungen et al., 2019). Owing to the emergence of the IoT, which connects numerous smart things with sensors and actuators to the Internet, digital services have evolved and given rise to smart services (Barrett, Davidson, Prabhu, & Vargo, 2015). The smartness of smart services eintails the integration of interconnected physical objects (i.e., smart things), which exist as boundary objects between the physical and digital worlds (Beverungen, Müller, Matzner, Mendling, & vom Brocke, 2019; Wuenderlich et al., 2015). Smart things further comprise capabilities such as information processing, knowledge acquisition, internal regulation, and external action (Alter, 2020). Given these features, a smart service might collect data through smart things (e.g., room temperature sensed by a smart thermostat) and command smart things to execute actions (e.g., the consumer increases the heating power in a room via a mobile app). Proactive services go one step further as they anticipate consumer demands and act on behalf of the consumer. Proactive services determine their actions based on the consumer’s personal and contextual data acquired through digital (i.e., software components) or physical (i.e., smart things) intermediaries as well as publicly available data (Hammer, Wißner, & André, 2015; Leyer et al., 2017). From this comprehensive consumer profile, proactive services extract goals, preferences, and behavior of the consumer; these data serve as the foundation for the prediction of the consumer’s current and future needs. Thus, proactive services enhance the characteristics they inherit from digital and smart services. For instance, a smart thermostat may not only sense and regulate the temperature based on the consumer’s input via mobile app (i.e., smart service), but also autonomously set the temperature based on the consumer’s past behavior, preferences, and anticipated needs (i.e., evolution to a proactive smart service).

Besides the delineation on digital and smart services, the research article #2 identifies the characteristics by which proactive services differ in the business-to-consumer context. To answer this question, the authors develop, apply, and evaluate a multi-layer taxonomy of proactive services. To the best of our knowledge, this work is among the first studies to conceptualize and understand proactive services in detail. Taxonomies help humans classify objects based on their characteristics (i.e., similarities and differences) and thus support researchers and practitioners to understand novel phenomena (Nickerson, Varshney, & Muntermann, 2013). While taxonomies have a long tradition across disciplines (e.g., in social sciences and biology), they gain relevance in the IS discipline that is particularly in demand to understand emerging phenomena given the rapid speed of technological progress (for details on the method, see Section II.3 and research article #5). Thereby, taxonomies represent theories for analyzing (theory type I) or describing the “what is” and lay the groundwork for more advanced theories of explanation, prediction, design, and action (theory types II to V) (Gregor, 2006).

To develop, apply, and evaluate a taxonomy of proactive services, the research article #3 shows a three-phased approach. In the first phase, the authors conducted a structured literature review of the top IS journals, major IS conferences, and practitioner-oriented journals following the guidelines of Webster and Watson (2002) and vom Brocke et al. (2015). From the resulting 426 academic articles, the authors selected articles discussing proactive services, service taxonomies, service-related aspects of proactivity, and real-world examples. Through manual and independent coding, the analysis yielded 45 examples of proactive services and 37 academic articles with theoretical considerations of relevant aspects. Both samples were used in the second research phase – the taxonomy development – following the well-established method by Nickerson et al. (2013). For the taxonomy, the authors defined the target users (i.e., researchers and practitioners), a clear purpose (i.e., describing, classifying, analyzing, identifying, and clustering proactive services), a meta-characteristic guiding the development process (i.e., the differentiating characteristics of proactive services related to consumer, data, and interaction in the business-to-consumer context), and subjective as well as objective ending conditions for the taxonomy development.

Subsequently, the authors developed the taxonomy (see Table 4) in three iterations both deductively (i.e., starting from the academic articles) and inductively (i.e., starting from the examples of proactive services). Structured by three layers – “Consumer,” “Data,” and “Interaction” – the taxonomy characterizes proactive services in nine dimensions with two to four characteristics each. While some dimensions can be considered exclusive (i.e., only one characteristic of the dimension can be observed for a specific proactive service), other dimensions are non-exclusive (i.e., more than one characteristic can be observed for a specific proactive service at the same time).

Layer	Dimension	Characteristics				Exclusivity
Consumer	Consumer Relief	Consideration	Consideration & Enactment	Consideration, Decision & Enactment		Exclusive
	Consumer Benefit	Time	Money	Flexibility	Quality	Non-exclusive
	Consumer Risk	Limited		Substantial		Exclusive
Data	Data Source	Personal Data		Contextual Data		Non-exclusive
	Data Analysis	Basic		Extended		Exclusive
	Smartness	Self-Controlled		Self-Learning		Exclusive
Interaction	Trigger	Time	Location	Social	Event	Non-exclusive
	Representation	Digital		Digital & Physical		Exclusive
	Integration	Stand-Alone		Ecosystem		Exclusive

Table 4: Taxonomy of proactive services as presented in research article #2

In the third research phase, the taxonomy was applied and evaluated to demonstrate its understandability and applicability, particularly in relation to the intended purpose of the taxonomy, as defined above. In illustrative scenarios, three exemplary proactive services were classified and described along the dimensions and characteristics of the taxonomy to demonstrate the taxonomy's applicability. Subsequent expert interviews confirmed the overall understandability of the taxonomy, its applicability, and its value to "unblackbox" and "demystify" the proactive services. While the overall evaluation of the experts (i.e., seven researchers and practitioners) was positive, the interviews also yielded outcomes that enhanced the taxonomy's understandability (i.e., changes in the taxonomy's presentation, the description of its dimensions and characteristics, and the description of the illustrative examples of proactive services).

With its detailed analysis of proactive services, the research article #2 contributed to a profound understanding of this emerging phenomenon in the context of digital services. In sum, the research articles #1 and #2 investigated two major concepts (i.e., privacy and proactivity) relevant to both research scholars and practitioners and applicable across industries.

2 Retail Commerce and Financial Services as Selected Industries

Besides the analysis of concepts valid across industries, this doctoral thesis sheds light on the specifics of digital services in selected industries. Thus, this section presents two research articles focusing on digital services in retail commerce (research article #3) and the financial services industry (research article #4).

Retail commerce refers to the activity of buying and selling products and services to consumers. Before the diffusion mail-order catalogs and teleshopping, brick and mortar stores were the linchpin for buyers and sellers (Miles, 1990). The new forms of commerce were driven by digital technologies. The Internet led to the emergence of electronic commerce (*e-commerce*), that is, the purchase of products via digital channels (Grandon & Pearson, 2004). These online shops eliminated temporal restrictions and, shortly after, mobile Internet-enabled devices removed spatial restrictions from shopping (Clarke, 2008). The proliferation of mobile commerce (*m-commerce*) created novel value propositions for consumers (e.g., location-based services).

Next to e-commerce and m-commerce, the advent of IoT devices (i.e., smart things) led to the emergence of another evolutionary option to purchase online. IoT devices are a multitude of physical objects, equipped with sensors, actuators, and/or computing power connected to the Internet via communication technology, and enabling interaction with and/or among those objects (Oberländer et al., 2018). The research article #3 focuses on the development of IoT-commerce, which refers to the use of IoT devices to purchase products and services online; given this, IoT-commerce affords new opportunities to consumers. An example of an IoT device is Amazon’s smart speaker Echo, whose voice command feature allows online order placement on Amazon’s online marketplace. In regard to the cross-industry concept of proactivity, described in the previous Section II.1, another example is a smart washing machine that keeps track of its detergent and automatically reorders detergent based on the anticipated consumption and without any consumer intervention.

Extant literature discusses only selected aspects of how organizations can leverage IoT devices to enhance value for consumers; they also focus on the application of IoT devices for energy savings, property protection, or personalized experience (Koverman, 2016; Lee & Lee, 2015). These studies have failed to identify the opportunities that IoT devices provide to consumers, in the context of retail commerce, despite the disruptive impact of IoT-commerce on the consumer buying process. Therefore, the research article #3 of this doctoral thesis addresses the question with a methodological foundation in activity and affordance theories. Developed by Vygotsky (1980) and Leont’ev (1978), the activity theory has been utilized in the domain of e-commerce; it formalizes the interaction of an individual subject with the world (Beaudry & Carillo, 2006; Chaudhury, Mallick, & Rao, 2001; Johnston & Gregor, 2000). In the context of IoT-commerce, the activity theory describes how a Person (i.e., consumer) interacts with an Object (i.e., retailer) via the use of a Tool (i.e., IoT device) (Benbunan-Fich, 2019). Thus, the activity theory is suitable for analyzing how consumers interact with the digital retail services using IoT devices. Repeatedly, activity theory is complemented by affordance theory (Benbunan-Fich, 2019). Hence, the research article #3 combines activity and affordance theories to introduce affordances as the relational property of the interaction between the Person-Tool-Object triad. Affordances originate from ecological psychology, where Gibson (1979) used the verb “afford” to describe what the environment offers to an animal. It was later introduced into the Human-Computer Interaction and abstracted from physical objects (Benbunan-Fich, 2019; Norman, 1988). The research article #3 follows this logic and interprets affordances as possibilities for consumers to act (i.e., order/buy products) towards an object (i.e., digital service of a retailer). The literature supports affordances as a useful lens to analyze emerging technologies (e.g., the IoT in retail commerce) in a user-centered manner (Gaver, 1991; Leonardi, 2011).

To identify opportunities for IoT-commerce consumers, research article #3 pursues a two-step approach: theory development followed by validation. In the first step, the authors conducted a structured literature search on e-commerce, m-commerce, and IoT-commerce, in line with the recommendations of Webster and Watson (2002). This review yielded 180 academic articles from the top journals of the IS, e-commerce, marketing, computer science, and electrical engineering domains. A detailed analysis of 49 relevant journal articles yielded valuable contributions to the IoT-commerce theory and produced a list of 12 affordances, of which seven originate from e-commerce, two from m-commerce, and three from IoT-commerce. The IoT-commerce affordances comprise *context-aware services*, *natural interactions*, and *automated consumer processes*. *Context-aware services* tailor their offering to the consumer's individual situation and context; it is made possible through the invasive nature of IoT devices that understand the consumer and its context more comprehensively based on sensor and usage data. These IoT devices also help consumers participate in new ways of *natural interaction;* such interactions are evident when customers coordinate buying processes through voice commands or gestures. Ultimately, IoT-commerce *automates consumer buying processes* through algorithmic decision making. In line with the cross-industry concept of proactivity (as described in Section II.1), digital retail services relieve the consumer from (parts of) the buying process and act on the consumer's behalf; this takes place based on the collected consumer data, the anticipation of consumer needs, and the proactive execution of actions.

The affordances of IoT-commerce materialize in one to several steps of the consumer buying process. For instance, natural interactions via voice command may materialize when searching for products; however, they do not necessarily come to use for payments. Lemon and Verhoef (2016) propose a consumer buying process with nine distinguishable steps, along with the stages *pre-purchase* (i.e., *need recognition, consideration, and search*), *purchase* (i.e., *choice, ordering, and payment*), and *post-purchase* (i.e., *consumption/usage, engagement, and service request*). Naturally, not every buying process follows this pattern exactly. Nevertheless, it provides an abstract conceptualization of the different steps and their typical sequence. Figure 3 visualizes the theory proposed by the research article #3 – a socio-economic activity system of IoT-commerce with its affordances and exemplary manifestations of these affordances along with the steps of the consumer buying process.

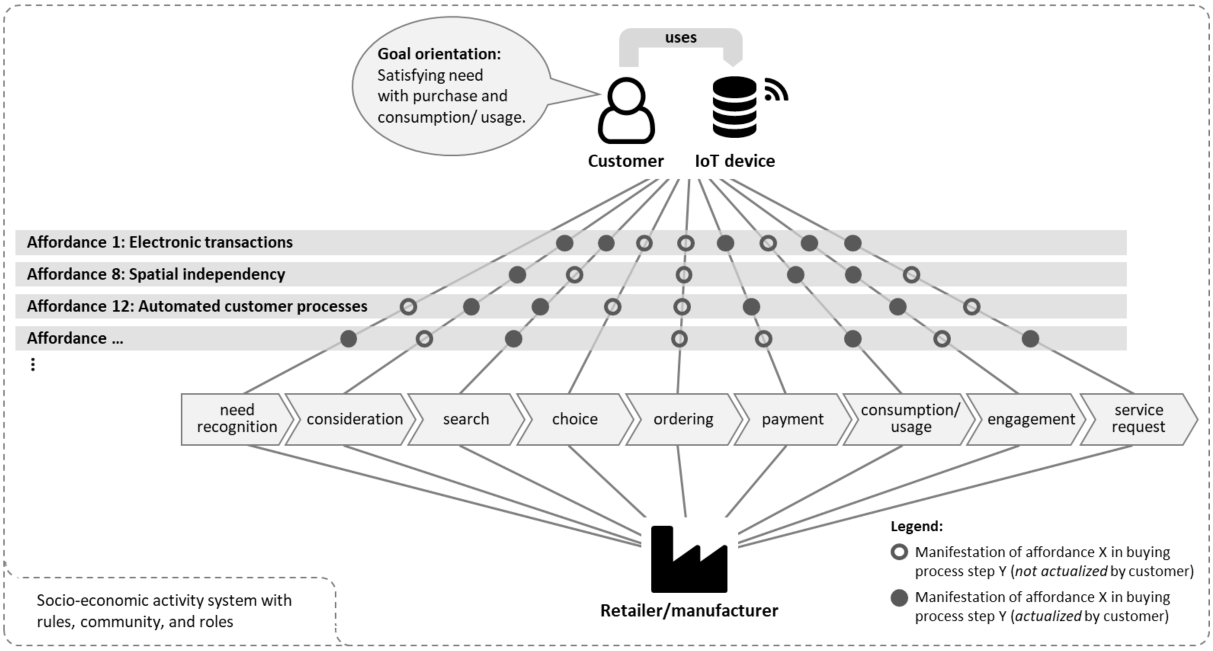

Figure 3: Activity system of IoT-commerce with its affordances and manifestations as presented in research article #3

In the second step of the research approach of the article #3, the developed theory was validated for completeness and parsimony with groups of real-world IoT devices. Extracted from three studies on IoT devices, an empirical sample of 337 IoT devices was analyzed, filtered, and grouped into five archetypes to complement theory development with empirical validation. To check for the parsimony of the theory, each affordance was applied to each step of the consumer buying process. If the archetypes of IoT devices confirmed that an affordance provides the possibility for action to the consumer (or removes the need to act due to proactive action), the authors documented the manifestation of the affordance. The authors retained only those affordances and manifestations that materialized through the archetypes of IoT devices. To check for the completeness of the theory, the reverse approach was chosen and all archetypes of real-world IoT devices were examined to determine their opportunities for consumers in the context of IoT-commerce. In this way, the theory was validated to ensure its parsimony and completeness. Table 5 presents the actual manifestation of IoT-commerce affordances in the interaction along with the steps of the consumer buying process.

Affordance group	Affordance	Customer buying process								
		Pre-purchase stage			Purchase stage			Post-purchase stage		
		need recognition	consideration	search	choice	ordering	payment	consumption/ usage	engagement	service requests
IoT-commerce affordances / m-commerce affordance / e-commerce affordances	Electronic transactions		●	●	●	●	●	●	●	●
	Temporal independence		●	●		●	●	●	●	●
	Online platforms			●	●	●	●	●	●	●
	Information transparency		●	●	●			●		
	Social interactions	●	●	●	●	●	●	●	●	●
	Personalized services	●	●	●						●
	Proactive services	●	●	●						●
IoT-commerce affordances / m-commerce affordance	Spatial independence		●	●		●		●	●	●
	Location-based services	●	●	●				●		●
IoT-commerce affordances	Context-aware services	●						●	●	●
	Natural interactions		●	●	●	●	●	●	●	●
	Automated customer processes	●	●	●	●	●	●		●	●

Table 5: Manifestations of IoT-commerce affordances along the consumer buying process as presented in research article #3

Besides the recent evolution of digital services in retail commerce, this doctoral thesis puts a spotlight on digital services in the financial services industry. The emergence of digital technologies such as social media, mobile computing, data analytics, and cloud computing also led to new opportunities for innovation in the financial services industry. Traditional financial institutions were initially cautious in the adoption of new digital technologies. However, the mostly innovative, tech-savvy, and non-financial start-up businesses were riding the wave of digitalization in the financial services industry – a phenomenon called "fintech". Denoting "financial technology", fintech has gained attention in the context of innovative business models since 2014 (Cambridge Dictionary, 2020; Google, 2020). It describes the fintech start-ups' use of digital technologies to offer consumer-centric digital services. Different functional domains of the financial services industry comprise fintech examples: from money transfer (e.g., TransferWise), wealth management (e.g., Wealthfront), and insurance (e.g., Friendsurance) to innovative functional domains such as cryptocurrencies (e.g., bitcoin.de) and crowdfunding (e.g., Bergfürst). For instance, the digital service of TransferWise offers international money transfers at a low cost and bitcoin.de allows consumers to buy and sell Bitcoin cryptocurrency online.

Despite massive investments and a steep evolution in practice, studies on fintech start-ups lack deep theoretical insights. These studies have failed to provide a non-functional perspective, which transcends the functional application domains of fintech start-ups . Hence, the research article #4 investigates the non-functional characteristics of consumer-oriented fintech start-up service offerings. Similar to the research article #2 in Section II.1, this research article develops and applies a taxonomy as a theory for analyzing (theory type I) and foundation for further theoretical studies (Gregor, 2006). The multi-layer taxonomy with 15 dimensions and 36 characteristics is organized along the non-functional perspectives *interaction*, *data*, and *monetization*. The authors applied the well-established taxonomy development method of

Nickerson et al. (2013). After the definition of a suitable meta-characteristic and the determination of objective and subjective ending conditions, the taxonomy development followed four deductive and inductive iterations.

Perspective	Dimension	Characteristics		
Interaction	*Personalization*	not personalized (61%)	personalized (39%)	
	Information exchange	pull (99%)	push (22%)	
	Interaction type	direct (28%)	intermediary (54%)	marketplace (18%)
	User network	isolated (78%)	interconnected (21%)	
	Role of IT	technology-mediated (24%)	technology-generated (76%)	
	Hybridization	service-only (89%)	with physical product (11%)	
	Channel strategy	digital exclusive (99%)	digital non-exclusive (1%)	
Data	*Data source*	user (93%)	peer (26%)	public (51%)
	Time horizon	historic (64%)	current (100%)	predictive (8%)
	Data usage	transactional (87%)	basic analytical (21%)	advanced analytical (9%)
	Data type	structured (97%)	unstructured (3%)	
Monetization	*Payment schedule*	none (11%)	transactional (44%)	subscription (29%)
	User's currency	attention (35%)	data (8%)	money (43%)
	Partner's currency	none (52%)	money (33%)	
	Business cooperation	stand-alone (85%)	ecosystem (15%)	

Note: Cumulated relative frequencies can be different from 100% if a dimension is non-exclusive or in case of missing data.

Table 6: Non-functional fintech taxonomy applied to the service offerings of 227 consumer-oriented fintech start-ups as presented in research article #4

Table 6 shows the non-functional fintech taxonomy applied to the service offerings of 227 consumer-oriented fintech start-ups sampled from online sources (e.g., start-up database Crunchbase and expert blog paymentandbanking.com) as well as reports (e.g., a consultancy study of KPMG and a report of Forbes Magazine). The percentages behind the characteristics of the taxonomy represent the proportional occurrence of the respective characteristics among the service offerings of the 227 fintech start-ups. The classification allows an examination of the diverse configurations of fintech service offerings and their frequent and rare characteristics as a prerequisite to understanding the antecedents of fintech success.

To identify frequent configurations (i.e., the combined occurrence of characteristics), the research article presents archetypes derived from a statistical cluster analysis. As such, a cluster analysis is used to group objects to achieve a high homogeneity within each cluster and high heterogeneity among objects of different clusters (Bacher, Pöge, & Wenzig, 2010; Backhaus, Erichson, Plinke, & Weiber, 2011; Cormack, 1971). The authors chose Ward's (1963) agglomerative hierarchical clustering algorithm along with the matching coefficient as the distance measure – both of which are often used in practical applications (Backhaus et al., 2011; Ferreira & Hitchcock, 2009; Finch, 2005; Fraley & Raftery, 2002; Hands & Everitt, 1987; Milligan, 1980; Milligan & Cooper, 1988; Saraçli, Dogan, & Dogan, 2013). The authors applied cluster analysis separately for each taxonomy perspective (i.e., *interaction*, *data*, and *monetization*).

Contingency table for perspectives data and interaction					
		Interaction			**Pearson's chi-squared test of independence**
		Personalized isolated	*Non-personalized isolated*	*Socially connecting intermediate*	
Data	*Standard processing*	61	110	38	χ^2 = 5.623
	Advanced analytics	9	9	0	p-value = 0.053
Contingency table for perspectives monetization and interaction					
		Interaction			**Pearson's chi-squared test of independence**
		Personalized isolated	*Non-personalized isolated*	*Socially connecting intermediate*	
Monetization	*No money*	17	17	13	χ^2 = 8.781
	User-paid	27	55	16	p-value = 0.058
	Business-paid	26	47	9	
Contingency table for perspectives data and monetization					
		Monetization			**Pearson's chi-squared test of independence**
		No money	*User-paid*	*Business-paid*	
Data	*Standard processing*	42	89	78	χ^2 = 1.730
	Advanced analytics	5	9	4	p-value = 0.451

Table 7: Contingency tables and Pearson's chi-squared test of independence among the archetypes of all three fintech taxonomy perspectives, as outlined in research article #4

Table 7 comprises the results of cluster analysis and shows the archetypes "personalized isolated," "non-personalized isolated," and "socially connecting intermediated" for the *interaction* perspective, "standard processing" and "advanced analytics" for the *data* perspective, and "no money," "user-paid," and "business-paid" for the *monetization* perspective. Further, Pearson's chi-squared test checked for the independence of the archetypes. Interestingly, the test indicates that the archetypes of the *data* and *monetization* perspectives are independent of each other, while there is dependence between the archetypes of the perspectives *data* and *interaction* as well as *monetization* and *interaction*.

In conclusion, the research article #4 conceptualizes the service offerings of fintech start-ups from a non-functional point of view. It allows describing, classifying, analyzing, identifying, and clustering service offerings and thus contributes to a theoretical and practical understanding of fintech start-ups as the spearheads of digital innovation in the financial services industry.

3 Taxonomy Research in Information Systems as Method Deep-Dive

As illustrated in the previous sections, via digital services, digital technologies pervade all areas of our professional and private lives (Legner et al., 2017). The evolution of digital services across industries is characterized by novel phenomena, such as the concept of proactive services (research article #2) and fintech (research article #4). These phenomena change established business rules and consumer relationships, and therefore demand theoretical analysis. The interdisciplinary IS discipline, in particular, plays an important role in analyzing and understanding such socio-technical progress. Owing to the to rapid technological progress, it has become essential to analyze these emerging technology-driven phenomena and ensure that literature keeps pace with the change. Taxonomies represent a suitable tool for the analysis of objects under consideration, based on commonalities and differences (Nickerson et al., 2013). Gregor (2006) describes such descriptive theories with the analysis of objects' dimensions and characteristics as theory type I (*theory for analyzing*) and thus an important foundation for more advanced theories. This view is supported by McKelvey (1982) that draws upon the work in biology, zoology, and botany to highlight the importance of systematics (i.e., delineation of uniform classes for a phenomenon under consideration). He calls this the *science of diversity* (McKelvey, 1982).

In the IS domain, Nickerson et al. (2013) were the first to propose a well-established method for taxonomy development that was also used in the research articles #2 and #4. Their structured method builds on methods from related disciplines such as biology and social sciences; it comprises seven steps and combines inductive and deductive approaches in an iterative manner. Its first step refers to the determination of a meta-characteristic that serves as the most comprehensive characteristic guiding the selection of all other characteristics in order to avoid naïve empiricism. In other words, the meta-characteristic describes the taxonomy's angle on the phenomenon under consideration. In the second step, the taxonomy designer selects objective and subjective ending conditions that later terminate the iterative taxonomy development process. In the third step, the taxonomy designer decides between an inductive iteration (e.g., to incorporate real-world insights) and a deductive iteration (e.g., to incorporate the taxonomy designer's knowledge) for steps four to six. In an inductive iteration, a subset of real-world objects is drawn and its common characteristics are derived and grouped into dimensions. In a deductive iteration, new characteristics and dimensions are conceptualized and subsequently validated with real-world objects. After every iteration, the taxonomy designer creates or revises the taxonomy. In the seventh step, the taxonomy designer checks all ending conditions and finalizes the iterative taxonomy development after all conditions are met.

Despite the method itself being cited and used by many authors, a structured review of 164 taxonomy articles published in IS outlets between 2013 and 2018 revealed that the application of the method often lacks transparency and taxonomies are rarely evaluated, presumably owing to the lack of guidance on taxonomy evaluation (Lösser, Oberländer, & Rau, 2019; Szopinski, Schoormann, & Kundisch, 2019). This may be partially be attributed to problems of execution. However, based on our reading of the literature, current methodologies’ lack of operational support, especially toward the evaluation of taxonomies, hinders the rigorous development of taxonomic theories, which, in turn, weakens their replicability and extensibility. After this thorough analysis of extant taxonomy literature in IS, the research article #5 proposes an extended process for taxonomy design (i.e., development and evaluation) and 26 operational recommendations.

Figure 4 complements Nickerson et al.'s (2013) process (white boxes) with additional/adapted guidance (grey boxes); this revised process is built on an extensive review of current taxonomy research in IS. The research article also provides a compiled overview of 26 recommendations that support the operational design of taxonomies in a rigorous, transparent, and replicable way. As the understanding of emerging technology-driven phenomena is crucial for the economy and society, the importance of taxonomies will further increase. Against this backdrop, the research article #5 strengthens the role of taxonomies as theories for analyzing and beyond. The research article #5 does not aim to replace extant guidance (e.g., from Nickerson et al., 2013); it augments guidance (e.g., taxonomy evaluation) and provides operational recommendations for fellow researchers.

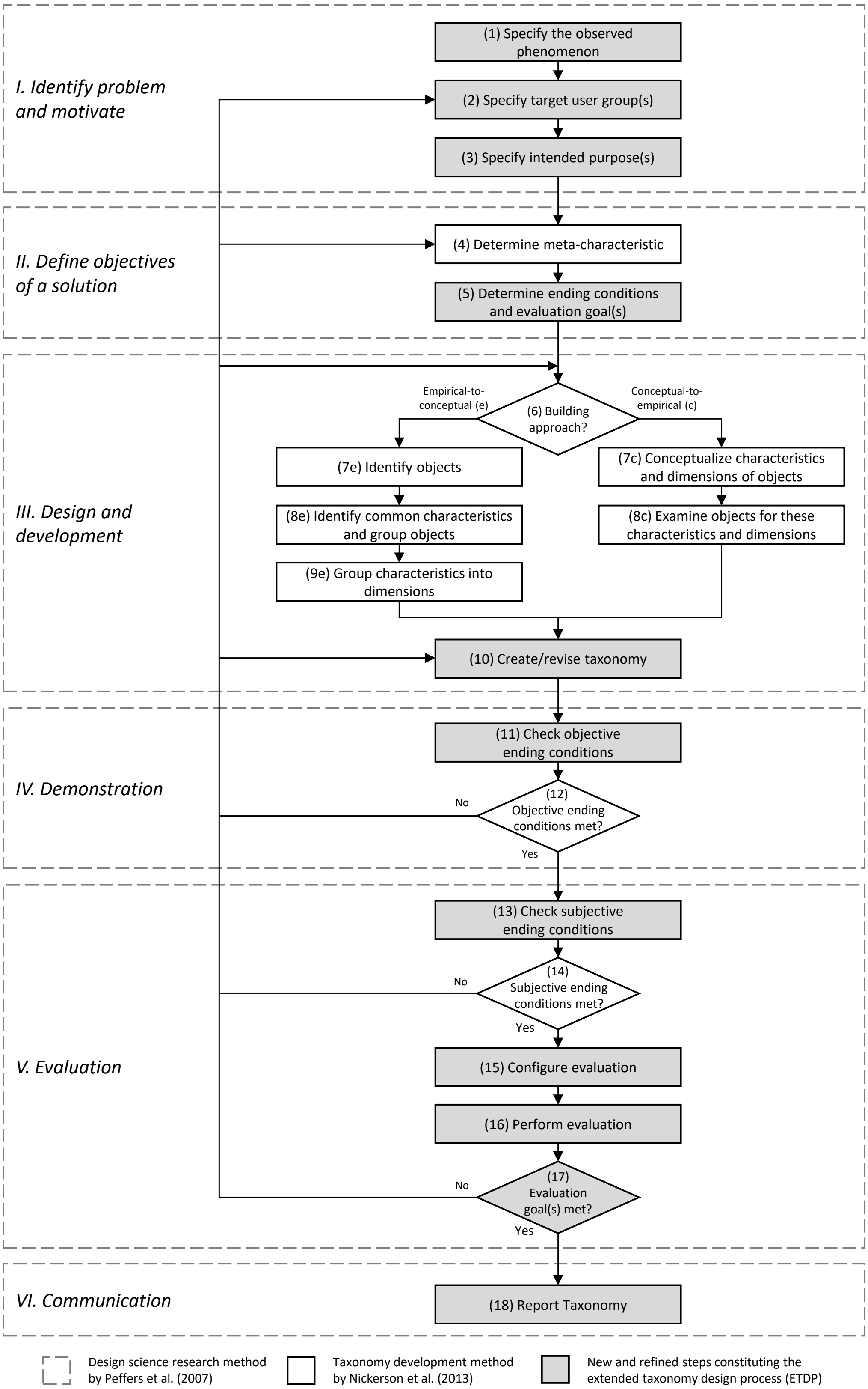

Figure 4: Extended taxonomy design process as proposed by research article #5

III. Conclusion

1 Summary

Organizations in all industries and even the government are offering digital services. Fueled by the emergence of digital technologies, these digital services enrich extant and create new value propositions for consumers. Thereby, they change the way organizations and consumers interact (e.g., via the use of smart things). In addition, the use of digital services enables the collection of novel forms of consumer data, which, in turn, enable new and innovative digital services. Given this context, this doctoral thesis analyzes digital services from two orthogonal perspectives while keeping its focus on the aspects of data and interaction. A cross-industry perspective sheds light on digital services in regard to the two major concepts of privacy and proactivity, whereas an orthogonal perspective highlights the specifics of digital services in the industries of retail commerce and financial services. It ends with a methodological deep-dive into taxonomy research in IS; a method used twice in this doctoral thesis to analyze novel phenomena related to digital services.

Concerning *Privacy and Proactivity as Cross-Industry Concepts,* Section II.1 presents two research articles that analyze privacy and proactivity as concepts relevant to digital services, independent of a specific industry. The research article #1 complements the research on data privacy with an upside perspective. Owing to the substantial effort related to the implementation of data privacy measures, organizations often refer to data privacy as a necessary evil; data privacy is often addressed from a risk minimization perspective. Based on an extensive analysis of legislative texts, selected data privacy statements of organizations, and expert interviews, the research article takes a consumer-centered approach and compiles data privacy measures addressing data privacy concerns of consumers. In two surveys, consumers evaluated these data privacy measures. An analysis, with its methodological foundation in the Kano model (Kano et al., 1984), showed that the implementation of specific data privacy measures enables organizations to delight consumers. This may serve as the basis for earning consumer trust and repositioning the perspective on data privacy from a necessary evil to an opportunity for differentiation, and thereby help organizations sustain competitive advantage in the long run. The research article #2 highlights proactivity as an emerging concept; it has played a crucial role in the recent evolution of digital services from smart to proactive services. The increasing diffusion of proactive digital services in the real world highlights the need for a detailed investigation of this phenomenon. Following the well-established taxonomy development method of Nickerson et al. (2013), this research article analyzes proactive services using both deductive and inductive approaches. As a taxonomic theory that allows for classifying objects (i.e., examples of proactive services) based on their characteristics, the applied and evaluated artifact of the research article #2 unblackboxes proactive digital services as a foundation for developing more advanced theories (Gregor, 2006).

Concerning *Retail Commerce and Financial Services as Selected Industries*, Section II.2 presents two research articles that analyze the specifics of digital services in the particular industries of retail commerce and financial services. The research article #3 showcases IoT-commerce as a new form of digital service in retail commerce based on smart things. With the evolution from e-commerce to m-commerce and now IoT-commerce, consumers have been given the opportunity to order products and services online via smart things such as smart speakers, smart washing machines, and other physical devices connected to the Internet. While the literature examined IoT from perspectives such as technical specifics, this research article discusses IoT in the context of retail commerce. It identifies novel opportunities that IoT-commerce affords to consumers. On the methodological basis of the activity theory (Benbunan-Fich, 2019; Leont'ev, 1978; Vygotsky, 1980) and the affordance theory (Benbunan-Fich, 2019; Gibson, 1979), the authors identified 12 affordances of IoT-commerce; these affordances are presented with their manifestations along the steps of the consumer buying process by Lemon and Verhoef (2016). As such, the research article #3 conceptualizes IoT-commerce as the evolution of e-commerce and m-commerce and contributes to a detailed understanding of the changes and opportunities in the interaction between consumers and online retailers. The research article #4 analyzes digital services in the financial services industry; these services are fueled by the technology-driven progress ushered by fintech start-ups' innovations. Previous literature characterized the service offerings of fintech start-ups mainly through a functional lens (e.g., payment, wealth management). This research article was (to the best of our knowledge) the first to take a non-functional perspective, highlighting the specifics regarding *interaction*, *data*, and *monetization*. Using the well-established taxonomy development method of Nickerson et al. (2013), the authors classify the service offerings of fintech start-ups in a deductive and inductive manner. An application to a sample of 227 real-world examples and a statistical cluster analysis resulting in generic archetypes revealed generalized insights into the development progress of fintech start-ups, in relation to *interaction*, *data*, and *monetization*.

Concerning *Taxonomy Research in Information Systems as Method Deep-Dive*, Section II.3 summarizes research article #5 as a methodological contribution of this doctoral thesis. Novel phenomena such as digital services require theoretical analysis as a foundation to more advanced theories and for gaining practical understanding. As theories for analyzing (*theory type I*), taxonomies represent a suitable tool to enhance the understanding of such emerging phenomena (Gregor, 2006). In IS, Nickerson et al. (2013) proposed a well-established method that is frequently used in research articles. Despite its high adoption, a structured review of the recently published taxonomy articles found that the taxonomy design process often remains vague and taxonomies are rarely evaluated; there has been a lack of operational guidance, particularly with regard to the evaluation of taxonomies (Lösser et al., 2019). Hence, the research article #5 augments methodological guidance with an extended taxonomy design process that explicitly comprises the evaluation of taxonomies; further, the research article provides 26 operational recommendations.

2 Limitations and Future Research

As with any research endeavor, this doctoral thesis is beset with some limitations and provides room for future research[4]. First, the research articles of this doctoral thesis deal with digital services in the business-to-consumer context. The research article #1 addresses data privacy for consumers, the research articles #2 and #4 conceptualize consumer-oriented proactive and fintech services, and the research article #3 investigates the affordances of IoT in retail commerce. Digital services in the business-to-business context are not discussed and therefore demand future research. For instance, proactive services and the IoT are also relevant for businesses, where they are already explored in the context of predictive maintenance and smart service systems. However, the upside of data privacy in business-to-business relationships and the significant potential of fintech start-ups addressing organizations instead of consumers are yet to be comprehensively understood.

Second, most of the research articles in this doctoral thesis are theories for analyzing. Thus, they represent theories of type I and are important theoretical contributions as they describe *what is* (Gregor, 2006). This is the case for the taxonomies of the research articles #2 and #4 and, to a large extent, for the research articles #1 and #3. Such type I theories are especially valuable when nothing or very little is known about a phenomenon. At the time of publication, this holds true for this thesis' research articles. However, the rapid progress and improved understanding of novel phenomena call for more advanced theories of type II to V in order to explain, predict, design, and prescribe phenomena. Future research should address this need and build on the conceptual basis of this doctoral thesis to develop an advanced understanding of digital services.

Third, the development of digital services and their adoption occur at an unprecedented speed and scale. This can be illustrated through comparison. While it took around three years for the Internet to reach 50 million users, the social network Instagram reached this threshold within six months. Even though this example is limited to only one platform, it supports the hypothesis of the high speed and scale of technological progress and consumers' openness towards it. This increases the number of phenomena that require detailed analysis, conceptualization, and understanding and challenges the validity of these make-to-evolve artifacts created by academic research. Hence, future research must regularly validate and, if necessary, revise and extend the theoretical body of knowledge in this doctoral thesis and beyond.

Despite its limitations, I hope this doctoral thesis advanced the theoretical understanding of digital services across industries and the related concepts of privacy and proactivity. Due to technological progress, the wind of socio-technical change will continue to blow. It is up to researchers, practitioners, and individuals to decide whether they want to engage in the construction of walls or windmills.

[4] Please refer to the individual research articles for details on limitations and future research.

IV. Bibliography

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V. Appendix

1 Index of Research Articles

Research Article #1: The Upside of Data Privacy: Delighting Customers by Implementing Data Privacy Measures

Gimpel, H., Kleindienst, D., Nüske, N., Rau, D., & Schmied, F. (2018). The Upside of Data Privacy: Delighting Customers by Implementing Data Privacy Measures. *Electronic Markets*, *28*, 437–452. Earlier version published in *Proceedings of the 13th International Conference on Wirtschaftsinformatik (WI 2017),* St. Gallen, Switzerland.

Research Article #2: Pushing the Frontiers of Service Research: A Taxonomy of Proactive Services.

Rau, D., Perlitt, L.-H., Röglinger, M., & Wenninger, A. (2020). Pushing the frontiers of service research: A taxonomy of proactive services. In *Proceedings of the 41st International Conference on Information Systems (ICIS 2020),* Hyderabad, India.

Research Article #3: IoT-Commerce: Opportunities for Customers Through an Affordance Lens

Bayer, S., Gimpel, H., & Rau, D. (2020). IoT-commerce: Opportunities for customers through an affordance lens. *Electronic Markets, forthcoming*, 1–24.

Research Article #4: Understanding FinTech Start-ups: A Taxonomy of Consumer-oriented Service Offerings

Gimpel, H., Rau, D., & Röglinger, M. (2018). Understanding fintech start-ups: A taxonomy of consumer-oriented service offerings. *Electronic Markets*, *28*(3), 245–264.

Voted as *Paper of the Year 2019* by the Associate and Senior Editors of the academic journal *Electronic Markets*.

Research Article #5: An Update for Taxonomy Designers: Methodological Guidance from Information Systems

Kundisch, D., Muntermann, J., Oberländer, A. M., Rau, D., Röglinger, M., Schoormann, T., & Szopinski, D. An update for taxonomy designers: Methodological guidance from information systems. *Business & Information Systems Engineering*, *work in progress (1st revision)*. Earlier version published in *Proceedings of the 27th European Conference on Information Systems (ECIS 2019),* Stockholm, Sweden.

2 Individual Contribution to the Research Articles

This doctoral thesis is cumulative and consists of five research articles that comprise the main body of work. All five research articles were developed in interdisciplinary teams with multiple authors. Hence, this section details the research settings and highlights my individual contribution to each research article.

Research article #1 (Gimpel et al., 2018) was developed with four co-authors, all of which contributed equally to the content of the research article. A former version of the research article was published in the *Proceedings of the 13th International Conference on Wirtschaftsinformatik (WI), St. Gallen, Switzerland, 2017*, and then extended. I designed the research method of the article, particularly for the identification of data privacy measures based on literature, legislative texts, and expert interviews. Subsequently, I engaged in the actual identification of these measures from the literature. Further, I was involved in the discussion of our findings and contributed to the revision of the research article.

Research article #2 (Rau et al., 2020) was developed with three co-authors with me being the lead author. Particularly, I substantially drove the definition of the research question and designed the research method. Thereby, I contributed my methodological experience in taxonomy design. Like all other co-authors, I engaged in the search and review of relevant academic literature and empirical real-world examples that both served as an input to the taxonomy design. For application and evaluation, I conceptualized, prepared, and led the seven expert interviews with researchers and practitioners. I also took a key role in the revision of the research article and coordinated the team of authors throughout the entire research project.

Research article #3 (Bayer et al., 2020) was developed with two co-authors. All co-authors equally contributed to the content of the research article. My specific role referred to the definition of the research question. Further, I designed the research method and embedded our work into the methodological foundation of Activity Theory and Affordance Theory. To visualize our key artifacts, I designed figures and set up tables that are included in the main part of the research article. I was also involved in the collection and analysis of real-world IoT devices, the literature-based derivation of affordances and manifestations, and the validation for completeness and parsimony. Ultimately, I substantially engaged in the revision of the research article.

Research article #4 (Gimpel et al., 2018) was developed with two co-authors. It represents an extension of a former version that was developed by the same team of authors and published in *Wirtschaftsinformatik & Management*. For both publications, I reviewed extant academic and commercial publications on the FinTech phenomenon. Further, I collected an empirical sample of 227 real-world FinTech start-ups from several sources and analyzed all start-ups regarding their commonalities and differences from a non-functional perspective. The results from this analysis contributed to the inductive development of the taxonomy. Besides, I coded 227 FinTech start-ups along the characteristics of our taxonomy and conducted a statistical cluster analysis to derive and describe archetypes. Although all co-authors contributed equally to the content of the research article, I was involved in each part of the project including the revision.

Research article #5 (Kundisch et al.) was developed with six co-authors, submitted to the academic journal *Business & Information Systems Engineering*, and is currently under its first *major revision*. It partly builds on a former research article that was published in the *Proceedings of the 27th European Conference on Information Systems (ECIS), Stockholm, Sweden, 2019*. After the conference, one of my two co-authors and I joined forces with researchers presenting a related research article at the conference and two other senior researchers. Together, the extended team of authors built on the descriptive insights on taxonomy development and taxonomy evaluation from the conference to develop prescriptive guidance on taxonomy design. I was particularly responsible for the design of the research method and specifically set up a literature sample that was coded jointly by me and three co-authors. Subsequently, I analyzed and visualized the results of the coding. Additionally, I supported the conceptualization of the taxonomy design process and recommendations, and in evaluatory interviews.

3 Research Article #1: The Upside of Data Privacy: Delighting Customers by Implementing Data Privacy Measures

Authors: Gimpel H., Kleindienst D., Nüske N., Rau D., & Schmied F.

Published in: *Electronic Markets*, 2018, 28, 437–452
Earlier version published in *Proceedings of the 13th International Conference on Wirtschaftsinformatik (WI 2017),* St. Gallen, Switzerland

Abstract: The targeted analysis of customer data becomes increasingly important for data-driven business models. At the same time, the customers' concerns regarding data privacy have to be addressed properly. Existing research mostly describes data privacy as a necessary evil for compliance and risk management and does not propose specific data privacy measures which address the customers' concerns. We therefore aim to shed light on the upside of data privacy. In this paper, we derive specific measures to deal with customers' data privacy concerns based on academic literature, legislative texts, corporate privacy statements, and expert interviews. Next, we leverage the Kano model and data from two internet-based surveys to analyze the measures' evaluation by customers. From a customer perspective, the implementation of the majority of measures is obligatory as those measures are considered as basic needs of must-be quality. However, delighting measures of attractive quality do exist and have the potential to create a competitive advantage. In this, we find some variation across different industries suggesting that corporations aiming to improve customer satisfaction by superior privacy protection should elicit the demands of their specific target customers.

Keywords: Privacy Concerns; Privacy Measures; Customer Data; Customer Satisfaction; Survey Research

4 Research Article #2: Pushing the Frontiers of Service Research: A Taxonomy of Proactive Services

Authors: Rau D., Perlitt L.-H., Röglinger M., & Wenninger A.

Published in: *Proceedings of the 41st International Conference on Information Systems (ICIS 2020),* Hyderabad, India

Abstract: Rapid advancements in digital technologies and data analysis led to a new service type. With their push-rationale, proactive services (PAS) are pushing the frontiers of traditional and even digital or smart services. Such PAS anticipate consumer needs and address them proactively. For instance, a smart fridge replenishes groceries in line with the consumer's preferences, based on anticipated demand, and without the consumer's intervention. In this paper, we contribute to a better understanding of the PAS phenomenon. Therefore, we propose a literature-backed and empirically validated multilayer taxonomy of PAS along the layers consumer, data, and interaction. Further, we compile a list of 45 PAS examples, demonstrate our taxonomy with three illustrative scenarios, and evaluate their understandability and applicability in seven interviews with domain and method experts. Based on gained insights on this rapidly emerging and important phenomenon, we highlight implications for both researchers and practitioners, and suggest future research directions.

Keywords: Taxonomy; Proactive Services; Digital Services; Smart Services

5 Research Article #3: IoT-commerce: Opportunities for Customers Through an Affordance Lens

Authors: Bayer S., Gimpel H., & Rau D.

Published in: *Electronic Markets*, 2020, 1–24

Abstract: Retail commerce is influenced by digital technologies at large scale. After electronic commerce and its evolution into mobile commerce, we now see that the Internet of Things (IoT), one of the most disruptive developments in recent times, is about to radically transform retail commerce from need recognition to post-purchase engagement and service. Extant literature mainly investigates technical features of IoT, missing out on a customer-centric perspective. Theoretically founded in Activity and Affordance Theories, this paper conceptualizes IoT-commerce, identifies opportunities for customers, and links them to the customer buying process. Based on an extensive literature review, twelve affordances are derived and evaluated with a sample of real-world IoT devices. All affordances offered by electronic and mobile commerce are still valid for IoT-commerce but extended by three affordances unique to IoT-commerce: context-aware services, natural interactions, and automated customer processes. Affecting all steps of the customer buying process, IoT-commerce is worth to be understood by researchers, customers, and companies.

Keywords: Activity Theory; Affordances; E-Commerce; M-Commerce; IoT

6 Research Article #4: Understanding FinTech Start-ups: A Taxonomy of Consumer-oriented Service Offerings

Authors: Gimpel H., Rau D., & Röglinger M.

Published in: *Electronic Markets*, 2018, 28(3), 245–264

Abstract: The financial sector is facing radical transformation. Leveraging digital technologies to offer innovative services, FinTech start-ups are emerging in domains such as asset management, lending, or insurance. Despite increasing investments, the FinTech phenomenon is low on theoretical insights. So far, the offerings of FinTech start-ups have been predominantly investigated from a functional perspective. As a functional perspective does not suffice to fully understand the offerings of FinTech start-ups, we propose a taxonomy of non-functional characteristics. Thereby, we restrict our analysis to consumer-oriented FinTech start-ups. Our taxonomy includes 15 dimensions structured along the perspectives interaction, data, and monetization. We demonstrate the applicability of our taxonomy by classifying the offerings of 227 FinTech start-ups and by identifying archetypes via a cluster analysis. Our taxonomy contributes to the descriptive knowledge on FinTech start-ups, enabling researchers and practitioners to analyze the service offerings of FinTech start-ups in a structured manner.

Keywords: Financial Services; Financial Technology; FinTech; Business Model; Services; Taxonomy

7 Research Article #5: An Update for Taxonomy Designers: Methodological Guidance from Information Systems

Authors: Kundisch D., Muntermann J., Oberländer A. M., Rau D., Röglinger M., Schoormann T., & Szopinski D.

Submitted working paper. Earlier version published in *Proceedings of the 27th European Conference on Information Systems (ECIS 2019)*, Stockholm, Sweden

Extended Abstract

Taxonomies support researchers in conceptualizing phenomena based on the classification of objects according to shared dimensions and characteristics. Apart from being artefacts for describing and classifying phenomena, taxonomies gain attention in Information Systems (IS) because they can also serve as a foundation for sense-making (Gregor and Hevner 2013) and theory building (Doty and Glick 1994). Nickerson et al. (2013) proposed a rigorous taxonomy development method for IS research to address the problem of 'ad-hoc' taxonomy building. Indeed, about two thirds of the taxonomies published in IS outlets and analysed in this study follow the method proposed by Nickerson et al. (2013). Despite the growing number of taxonomies and the high adoption of Nickerson et al.'s (2013) method, IS researchers still face challenges in taxonomy building and evaluation. With regard to taxonomy building, we found that applying Nickerson et al.'s (2013) method lacks clarity, which we attribute – at least partly – to the fact that there is only little guidance on how to implement the individual steps of the taxonomy development method. Regarding their evaluation, we found that taxonomies are rarely evaluated and there is hardly any guidance on how to evaluate them. Against this backdrop, we raise the research question: *How should taxonomies be built and evaluated?*

To assess the status quo of taxonomy design in IS and to identify examples of good practice, we took a two-phased approach. First, we conducted a systematic literature review resulting in 164 articles building and/or evaluating a taxonomy. Second, we coded the resulting articles along multiple attributes to gain insights into the operationalization of taxonomy building and evaluation. Thereby, we identified 'good practices' as specific operationalizations of a taxonomy design step that benefit a transparent and replicable taxonomy design approach. Based on the systematic analysis of how taxonomies have been built and evaluated in IS research since the publication of Nickerson et al. (2013), we provide an update for taxonomy designers methodologically augmenting taxonomy design in IS research.

Our study contains two contributions. First, we extend existing methodological guidance on taxonomy design regarding the evaluation of taxonomies. Second, we explicate this guidance for both taxonomy development and evaluation. As a result, we propose an extended taxonomy design process (ETDP). This ETDP incorporates the seminal work of Nickerson et al. (2013) and is embedded in design science research

(DSR). To that end, we organise the ETDP along the six activities of the widely-accepted, iterative DSR methodology proposed by Peffers et al. (2007). In addition, we provide 26 taxonomy design recommendations (TDR) as prescriptive guidance along the steps of the ETDP. These TDR represent actionable advice and are compiled from ‘good practices’ of taxonomy design observed in our systematic literature review. All TDR are presented with exemplary references that each implement the specific recommendation.

In evaluative interviews, five taxonomy experts provided feedback on the understandability and usefulness of the ETDP and TDR. Based on their experience and reflection of taxonomy design and publication processes in IS, the experts consistently agreed with the assessment of the ETDP and the TDR as highly relevant. All taxonomy experts provided extensive and constructive feedback that was, afterwards, comprehensively and collaboratively reflected upon by the author team.

By explicating and extending existing methodological guidance, this study contributes to the prescriptive knowledge on taxonomy design and seeks to facilitate rigorous taxonomy building and evaluation.

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Peffers K, Tuunanen T, Rothenberger MA, Chatterjee S (2007) A design science research methodology for information systems research. Journal of Management Information Systems 24:45–77