Strategic Service Innovation:
A Human-Centered
Mixed-Methods Approach

Inauguraldissertation
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vorgelegt von

Nicolai Krüger

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Preface

To honor those who have enabled me to undertake this research, I wish to mention some of the people who have made my dissertation with its ambitious challenges possible.

Firstly, I would like to express my gratitude to my advisor, Prof. Dr. Frank Teuteberg, who welcomed my research idea openly and guided me entirely remotely (even before the pandemic) throughout this journey with scientific incision as well as understanding and patience for the unexpected situations external Ph.D. candidates face. Furthermore, I would like to express my special thanks to Prof. Dr. Oliver Thomas for co-advising this thesis.

Within the team of the UWI-institute, my utmost appreciation goes to Ms. Marita Imhorst, Ms. Alina Behne, and Dr. Jan Heinrich Beinke for their consistent teamwork and feedback as well as to alumni Prof. Dr. Volker Frehe and Prof. Dr. Daniel Burda, whose support was cherished particularly at the beginning and end of this project.

Furthermore, I received incredible support, ideas, and feedback from several people I met in my professional life who helped me to follow the academic path: Prof. Dr. Agnis Stibe became not just a co-author and guide but also a friend. In addition to collaborating on numerous joint projects, Prof. Dr. Gerhard Satzger, Prof. Dr. Falk Uebernickel, Prof. Dr. Gerhard Hellstern, and Prof. Dr. Susanne Staude always found time to encourage my research endeavors and shared their visions of impactful research with me.

Above all, without the tireless enthusiasm and love of my partner and wife Jacqueline, this work would simply not exist. From the bottom of my heart, I thank her for supporting me through tough times, sharing her outstanding analytical skills, and believing in me. I am beyond grateful for my son Marius, who serves as an example in his passion for life and who always keeps me busy with his endless energy, preventing me from having time to doubt my work.

Finally, I close this preface by remembering the person to whom I owe everything and whom I never met: my mother, Margitta Krüger (†).

Mülheim an der Ruhr, April 2021
Nicolai Krüger

Notes on the Structure of the Document

This doctoral thesis is a cumulative work. Thus, Part A presents the research motivation and introduces the topic of Strategic Service Innovation in the Digital Age. Research questions and the chosen research path and methods are described. Those research projects of the author that were best suited to fit within the scope of this dissertation are summarized, including published research results and the subsequent discussion of implications for academia and practice. Over-all learning and implications are aligned within a Strategic Service Innovation framework as a comprehensive artifact of this document.

Part B presents the here discussed publication in its original format and is embedded into this document according to formatting regulations. Referencing in Part B is independent from Part A; thus, each publication includes its own list of references.

Contents

Part A: Introductory Overview

List of Abbreviations

AI	Artificial Intelligence
BMI	Business Model Innovation
CWA	Corona-Warn-App
DSR	Design Science Research
DT	Digital Transformation
EU	European Union
FMS	Fleet Management System
GUI	Graphical User Interface
HLR	Home Location Register
ICT	Information Communication Technology
IoT	Internet of Things
IS	Information Systems
ISO	International Organization for Standardization
OSINT	Open-source Intelligence
OSN	Online Social Network
PLS-SEM	Partial Least Squares Structural Equation Model
PSM	Privacy Scoring Model
RQ	Research Question
SSI	Strategic Service Innovation
TAM	Technology Acceptance Model
UX	User Experience
WOL	Working out Loud

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1   Introduction

1.1   Motivation

> *"Design is not just what it looks like and feels like. Design is how it works."*

<div align="right">Steve Jobs (†), co-founder of Apple Inc. and technology innovator (Serrat, 2017, p. 132)</div>

As a key purpose of the information systems (IS) discipline, designing and providing new services with the help of information communication technology (ICT; Becker et al., 2003) likely never received the amount of public attention as during the unprecedented situation where this doctoral thesis is originated, the coronavirus disease 2019 (COVID-19) pandemic. From corona tracing apps, appointment services for vaccinations, and booking services for COVID-19 tests to digital vaccination passports, the list of rapidly evolving services resulting from the pandemic is far-reaching (Thomas et al., 2020), and their acceptance by the public of utmost importance (Trang et al., 2020). Since the degree of human centricity of a service is considered crucial for its success (Gartner, 2020; Hehn, 2020), it is important to scrutinize whether services are human-centered,[1] whether they belong to a strategic roadmap, and – if not – the extent to which human centricity and Strategic Service Innovation would make a difference in their success, acceptance and maturity. To answer these introductory questions – including beyond the exemplary context of the pandemic – major underlying theories and concepts must first be clarified. Today, service innovation is in almost every product-oriented development component of the total package of a product, especially with the possibilities of sensor-based technologies on the Internet of Things (IoT) or Industry 4.0 (Kammler, 2019). To clarify the intersection of service innovation and human centricity, Vorraber et al. (2019) noted,

> "Overall, it is important to understand service innovation in a socio-techno-economic context. Viable service and business innovation jointly optimize the fulfilment of user needs in a specific organizational context, which is again embedded and interrelated with a surrounding external environment" (p. 5).

With regard to strategy, IS can – in contrast to economics – provide a perspective combining information technology (IT), economics or business administration, and behavioral psychology (Österle et al., 2010). As a result of the digital transformation (DT), which many organizations

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[1] The expressions human-centered, user-centered and people-centered are used interchangeably within this thesis

have undergone in recent years or are currently facing, IT in general has faced a shift from functioning as an internal department to becoming the core of many business models (Urbach & Ahlemann, 2016).

Grounded in socio-technical system theory (Emery & Trist, 1960), requirement engineering (RE) aims to provide a framework for gathering functional and non-functional software-features. Human-centered design intends to enrich the classic RE approach through a broader set of tools by applying an empathetic, user-conscious perspective to non-observational needs (Hehn, 2020). Beyond the popularity of agile practices, methods, workshop formats, and evidence-based guidelines already exist (ISO, 2019; Thomas et al., 2008). Gartner (2020) defined people centricity as follows: "Although the pandemic changed how many people work and interact with organizations, people are still at the center of all business. And they need digitalized processes to function in today's environment". Dörner et al. (2011) underlined the strategic dimension of service innovation, commenting that "many managers who make investment decisions do not fully recognize the value of service innovation as a competitive advantage" (p. 37). Den Hertog et al. (2010) linked the theory of Dynamic Capabilities with Strategic Service Innovation and claimed that "dynamic service innovation capabilities are aligned with firm strategy, market dynamics and firm history" (p. 498).

Combining the four described challenges, this dissertation addresses the research gap regarding human-centered Strategic Service Innovation (cf. Figure 1). While socio-technical systems build the foundational theory, human-centered design is a fairly young paradigm in contrast. Though RE is a regulated and standardized engineering discipline for designing hardware and software, service innovation offers modern innovation management concepts for rapidly evolving technologies such as blockchain, the IoT, or artificial intelligence. Thus, this thesis aims (cf. Section 1.2) to investigate how a combination of these four elements can be developed.
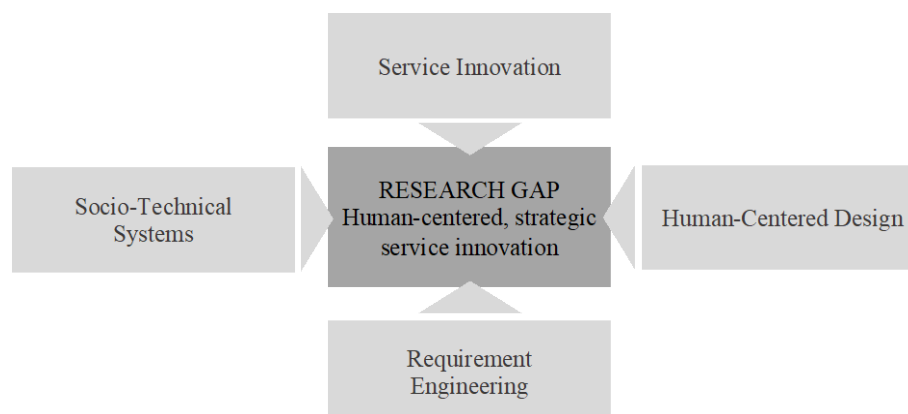

Figure 1: Derivation and development of the research gap

1.2   Aim

Given the motivations described in the previous Section, this dissertation aims to investigate the general characteristics of Strategic Service Innovation and how service innovation can be applied to different domains using human-centered design.

Innovation frameworks in general and service innovation frameworks in particular are typically objects of IS research (e.g., Behne et al., 2021) but are also common to other disciplines like marketing or economics (Bonazzi & Zilber, 2014; Schäperkötter, 2018). These frameworks are not only important for practitioners as distillations of best practices and for researchers by creating empirical evidence to support certain approaches, but they are also relevant to the academic curriculum in the mentioned disciplines as a scientifically driven explanation of how service innovation can be fostered. The latter is a secondary research goal in this dissertation and is of special interest for startup-oriented curricula. However, the primary research goal of this dissertation is based on the research gap regarding empirical evidence of Design Science Research projects and the more practice-driven approaches of agile development and Design Thinking (as the most popular human-centered service innovation approach). Indeed, Design Thinking in research divides the scientific community because empirical evidence is rare and agile practices are not necessarily on the theory-driven level as scientific methods, as shown by ongoing debate between the Design Thinking and Design Science Researchers (Da Silva et al., 2011; Dolak et al., 2013). Nonetheless, science can make use of agile formats to generate research knowledge, organize research projects, or create modern academic classes based on Design Thinking (Hehn et al., 2018; Vogel et al., 2020; Wiesche et al., 2018).

Interestingly, elements like iterative approaches and customer feedback have been known to IS for decades and were partially regulated in ISO 210. Thus, beyond the hype surrounding agile methods, pushing the existing body of knowledge towards a more integrative perspective on service innovation and providing a Strategic Service Innovation framework seem worthwhile, which are roughly described by Dörner et al. (2011) as structural factors for service innovation.

In short, this doctoral thesis aims to contribute to service innovation research using a mixed-methods approach (Recker, 2013; Venkatesh et al., 2013, 2016). In general, Strategic Service Innovation (SSI) aims to create novel digital service concepts ranging from radical technical innovations to business model pivoting. To deliver tangible contributions, each of the publications in this dissertation is directed towards a specific service innovation. In addition to the

research framework (cf. Section 2.2), Table 1 presents the individual research questions (RQs) of each contribution as well as a guiding high-level RQ for each group within the framework.

RQ	Research Question	Contribution
	SSI Strategy, Process and Operations	
1	**How can Strategic Service Innovations be applied to the consulting field as part of Digital Transformation?**	
1.1	Why do the (IT) consulting role models seem to vary in the context of Digital Transformation initiatives?	B
1.2	How does Digital Transformation affect the scope and approach of consulting firms?	B
1.3	Which key-drivers for Digital Transformation exist within consulting companies in general?	C
1.4	In a digitalized world, how could a business model for an IT and innovation focused consulting company look like?	C
	SSI Enabler	
2	**Which factors can foster or disturb the emergence of Strategic Service Innovation?**	
2.1	How can change and product innovation management enable the effectiveness (e.g., in terms of cost-savings or additional turnover) of big data initiatives?	A
2.2	Which change and product innovation management enablers (e.g., communication, transformation strategy and so forth) can be applied for smart metering within energy informatics?	A
2.3	Which basic business models can be described for intra-fleet and inter-fleet platooning?	D
2.4	How could a market for inter-fleet platooning look like, based on the current data available?	D
	SSI Outcome	
3	**What are characteristics of human-centered Strategic Service Innovation?**	
3.1	Can the matchmaking problem in the context of platooning be solved by a platform provider and what economic potential does such a matchmaking business model offer?	E
3.2	How can the incentivisation of platooning participants be solved fairly?	E
3.3	How can tracing and tracking apps be classified?	H
3.4	Which factors can improve the use intention and usage of corona tracing apps and in general social-participial apps?	H
3.5	Which design and functional elements of the German COVID-19 tracing app (Corona-Warn- App) should be enhanced to increase its acceptance?	I
	SSI Foundations	
4	**Which general foundations for SSI are needed?**	
4.1	Which requirements and implications arise for social media and mobile phone privacy from a privacy scoring model (PSM)?	F
4.2	To which extend do hackathons foster digital learning outcomes?	G
4.3	What lessons can be learned for applications in crisis management from the challenges of the Corona-Warn-App?	I

Table 1: Research questions in the outline of the dissertation

1.3   Structure

The structure of this dissertation (cf. Figure 2) is based on two major components. Part A covers the motivational and target-setting aspects of the thesis in Section 1. Section 2 describes the research design through context-creation for the selected publications, after which an innovation framework is derived to summarize and conceptualize the information. The framework is justified by a presentation of the underlying methods of the research project. Section 3 summarizes the most important findings from the publication selection. In the case of Contribution E, which was published in German, the library information was translated for this thesis. To avoid redundancies to the complete paper reprints in Part B, contributions are not only summarized

but brought into the broader storyline of the SSI, accompanied by a description of the major artifacts and learnings.

The discussion in Section 4 reveals implications for the scientific audience and practitioners. The potential scope of future research and limitations of this thesis close the discussion. Finally, Section 5 concludes by providing a brief summary of the overall thesis. Separately, Part B presents the research publications in their original format, language, and layout and contains the full list of references and appendices for each publication.

Part A			
1. Introduction			
1.1 Motivation	1.2 Aim	1.3 Structure	
Service Innovation	Requirement Engineering	Human-Centered Design	Socio-Technical Systems
2. Research Design			
2.1 Selected Contributions	2.2 Research Framework: SSI	2.3 Applied Methods	
3. Summary of Research Contributions [#]			
3.1 SSI Strategy, Process, Operations [B + C]	3.2 SSI Enabler [A + D]	3.3 SSI Outcome [E + H + I]	3.4 SSI Foundations [F + G + I]
4. Discussion			
4.1 Implications for Research	4.2 Implications for Practice	4.3 Limitations & Future Research	
5. Conclusion			
Part B			
Reprint Contributions in Full and Original Format			

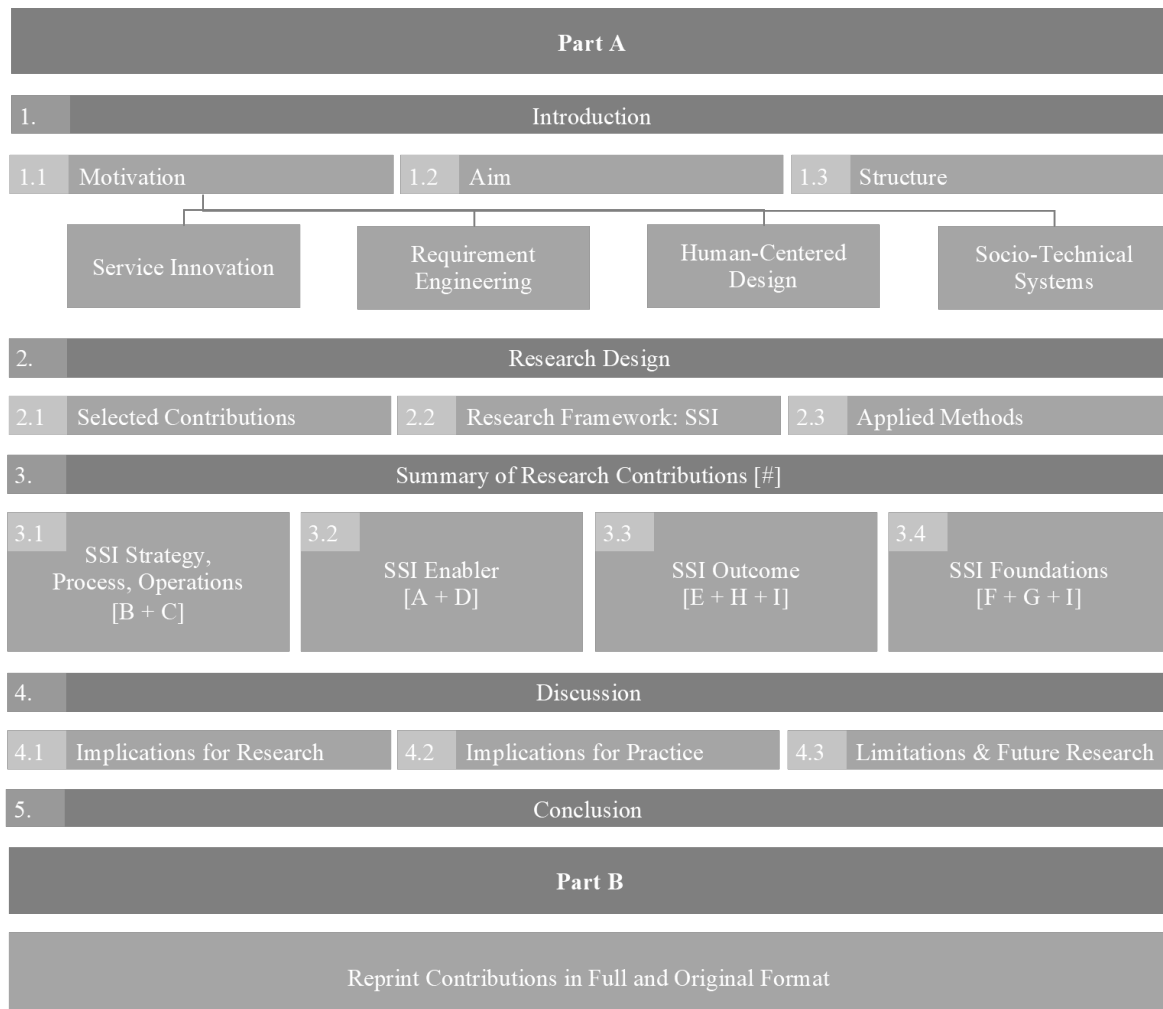Figure 2: Structure of the dissertation

2   Research Design

2.1   Selection of the Research Contributions

Several publications of this dissertation contribute to the body of knowledge in the IS discipline. Only peer-reviewed outlets, mainly in English, examined the work of this dissertation. Table 2

provides the list of publications which are part of this work. The remainder of this dissertation refers to these publications under the given ID # from Table 2. In addition, medium and reference are presented as well as rankings. For an IS faculty located in Germany, the ranking list of the Wissenschaftliche Kommission für Wirtschaftsinformatik (WKWI, 2008) is of the utmost importance, as is the JOURQAL3 (VHB, 2015) of the *Verband der Hochschullehrer für Betriebswirtschaft e.V.* (VHB). However, for joint international research projects, other ranking factors were taken into account. Further publications have addressed adjacent topics but are omitted here to maintain the focus on the research topic.

#	Title *(Translation)*	Medium	Ranking	Publication Sources
A	From Smart Meters to Smart Products	Conference	WKWI: C VHB: C	**Krüger, N.**, & Teuteberg, F. (2015). From smart meters to smart products: reviewing big data driven product innovation in the European electricity retail market. *INFORMATIK Proceedings*, 1171–1182.*[1]
B	IT Consultants as Change Agents in Digital Transformation Initiatives	Conference	WKWI: C VHB: C	**Krüger, N.**, & Teuteberg, F. (2016). IT consultants as change agents in digital transformation initiatives. *Proceedigs of Multikonferenz Wirtschaftsinformatik*, 1019–1030.*[1]
C	Consulting Business Models in the Digital Era	Conference	WKWI: C VHB: C	**Krüger, N.**, & Teuteberg, F. (2018a). Consulting business models in the digital era. *Data driven X–Turning Data into Value 3*, 1273–1284.*[1]
D	Truck Platooning: Towards Future Business Models	Conference	WKWI: C VHB: C	**Krüger, N.**, & Teuteberg, F. (2018b). Truck platooning: Towards future business models. *Proceedigs of Multikonferenz Wirtschaftsinformatik*, 3–9.*[1]
E	XPlatoon - Simulation and prototyping of an intermediary model for truck platooning	Conference	WKWI: - VHB: -	**Krüger, N.**, & Teuteberg, F. (2019). XPlatoon–Simulation und Prototypisierung eines Vermittlermodells für LKW-Platooning. *BUIS Proceedings*, 85–95.*[1]
F	The Black Mirror: What Your Mobile Phone Number Reveals About You.	Conference	WKWI: B VHB: -	**Krüger, N.**, Stibe, A., & Teuteberg, F. (2020). The Black Mirror: What Your Mobile Phone Number Reveals About You. International Conference on Business Information Systems. Springer, Cham. *[1] *[2]
G	Are Hackathons the New e-Learning Environments? On the Outcome of the #WirVsVirus Hackathon From a Learning Outcome Perspective	Conference	WKWI: - VHB: -	**Krüger, N.**, & Teuteberg, F. (2020). Are hackathons the new e-learning environments? On the outcome of the #WirVsVirus hackathon from a learning outcome perspective. *ECONF*.*[1]
H	Exploring user acceptance determinants of COVID-19-tracing apps to manage the pandemic.	Journal	WKWI: - VHB: - JIF: 0.7	**Krüger, N.**, Behne, A., Beinke, J.H., Stibe, A., Teuteberg, F. (2022). Exploring user acceptance determinants of COVID-19-tracing apps to manage the pandemic. *International Journal of Technology and Human Interaction*, 18(1), 1-27.*[1]*[3]
I	Learnings from the design and acceptance of the German COVID-19 tracing app for IS-driven crisis management: A design science research	Journal	WKWI: - VHB: - JIF: 2.32	Behne, A., **Krüger, N.**, Beinke, J.H., & Teuteberg, F. (2021). Learnings from the Design and Acceptance of the German COVID- 19 Tracing App for IS-driven Crisis Management: A Design Science Research. *BMC Medical Informatics and Decision Making*, 21(1), 1-22. *[1]*[4]

Comments
*[1] Prof. Dr Frank Teuteberg is a co-author of each publication; he critically reflected on the content and the methodological orientation of each contribution.
*[2] Prof. Dr. Agnis Stibe provided methodological support and collaborated on the concept of the paper.
*[3] The author of this dissertation and Ms. Alina Behne worked in equal parts on the paper. The methodological orientation, discussion of the results, and writing of the implications took place collaboratively with Dr. Jan Heinrich Beinke and Prof. Dr. Agnis Stibe.
*[4] The author of this dissertation and Ms. Alina Behne worked in equal parts on the paper. The methodological orientation, discussion of the results, and writing of the implications took place collaboratively with Dr. Jan Heinrich Beinke.

Legend
VHB = Verband der Hochschullehrer für Betriebswirtschaftslehre (*Translation: German Academic Association for Business Research*) – Journal Quality Index 3 (VHB, 2015)
WKWI = Wissenschaftliche Kommission Wirtschaftsinformatik – Orientierungsliste 2008 (*Translation: Scientific Commission Information Systems – Guidance List 2008*) (WKWI, 2008)
JIF = Journal Impact Factor according to resurchify

Table 2: Selected research contributions

2.2   Framework of the Research Contributions

The research endeavor of this cumulative dissertation contributes to research through an integrative perspective on service innovation (cf. Figure 1) by presenting a Strategic Service Innovation (SSI) framework (cf. Figure 3). Since service innovations are strategically induced, an overarching innovation strategy is needed to form a company's vision, corporate culture, and so on. These factors give a strategic direction to innovation action steps and define the search field for technology-driven innovation (Gassmann et al., 2018). Innovations, and especially human-centered innovations, should create strategic benefits, e.g., when taking tomorrow's users or customers into consideration or pivoting the own business model. Contribution B reveals the paradigm shift consulting firms currently face under the influence of digital transformation and its consequences. A fundamental change in the IT business model and strategy consulting firms has been observed. Contribution C deals with the necessary changes to consultants' individual skills in order to reflect the new strategic orientation of advisory firms.

A variety of enablers and input variables can be derived from literature on SSI. However, Contribution A focuses on one exemplary enabler by analyzing the data-driven innovation journey of energy suppliers in Europe. In 2015, the concrete effects of the European Union's new smart meter regulations (European Union, 2006) were on the horizon: Smart meters were part of the first private homes, and the strategic foresight and implications of the contribution matched with the new state of the market mechanism as of today (Doukas, 2021).

In the center of the framework, processes and operations take place that are needed to transform the SSI enabler and apply variables to value creation, value proposition (Osterwalder et al., 2014), and concrete outcomes (Kolbusa, 2014). While stage-gate models for service innovation produce decreasingly deterministic innovation outcomes, the SSI framework provides an alternative view: a successful implementation of SSI processes may lead to continuous growth of ideas, prototypes and refinements as well as bisociative ideas. As in this dissertation, the platooning ecosystem simulation in Contribution D led to the prototype of XPlatoon in Contribution E, the enhancements of the Corona-Warn-App to another interactive prototype in Contribution I. Although these artifacts (i.e., innovation) build upon each other, they would not fit into classical innovation funnels. These ideas are rather two different ideas stimulated by one another; hence, this dissertation suggests calling these *symbiotic ideas*. This concept is comparable to the increasing creativity flow in the Design Thinking macro process. From so-called

design space exploration and the funky prototype to the final prototype, ideation and creativity widen the innovation process instead of narrowing it (Hehn, 2020).

The purpose of the SSI framework is twofold. Firstly, different kinds of outcomes might be achieved. Based on Kolbusa (2014), the desired outcome of managerial action steps is a future perspective of the company that is aligned with the strategy. In contrast, the output is a result on a smaller scale of a process, which might be measurable in classical performance indicators, like, by way of illustration, the amount of patents or app downloads in a given timeframe. Contribution E contains a high-fidelity prototype for truckers that joined a platoon of trucks on the same route. A different kind of outcome can be seen in Contribution H, which gives clear recommendations to achieve mass acceptance of corona tracing applications. Secondly, these outcomes might influence the future strategic steps of an organization; this important feedback loop can be described using the interdependencies of the consulting-related contributions (B+C) and the platooning technology contributions (D+E) of this thesis. Finally, the SSI framework is grounded in several foundations, which are highly recommended in practical SSI but also reflected in the service innovation research field. One aspect of the SSI foundations is risk management, which is covered in Contribution F and has a special focus on privacy risks for individual (social media) services. Moreover, lifelong learning became an increasingly discussed

pattern for individuals and organizations. Thus, the findings of contribution G can inform understanding of a new format of hackathons in terms of their learning outcomes.
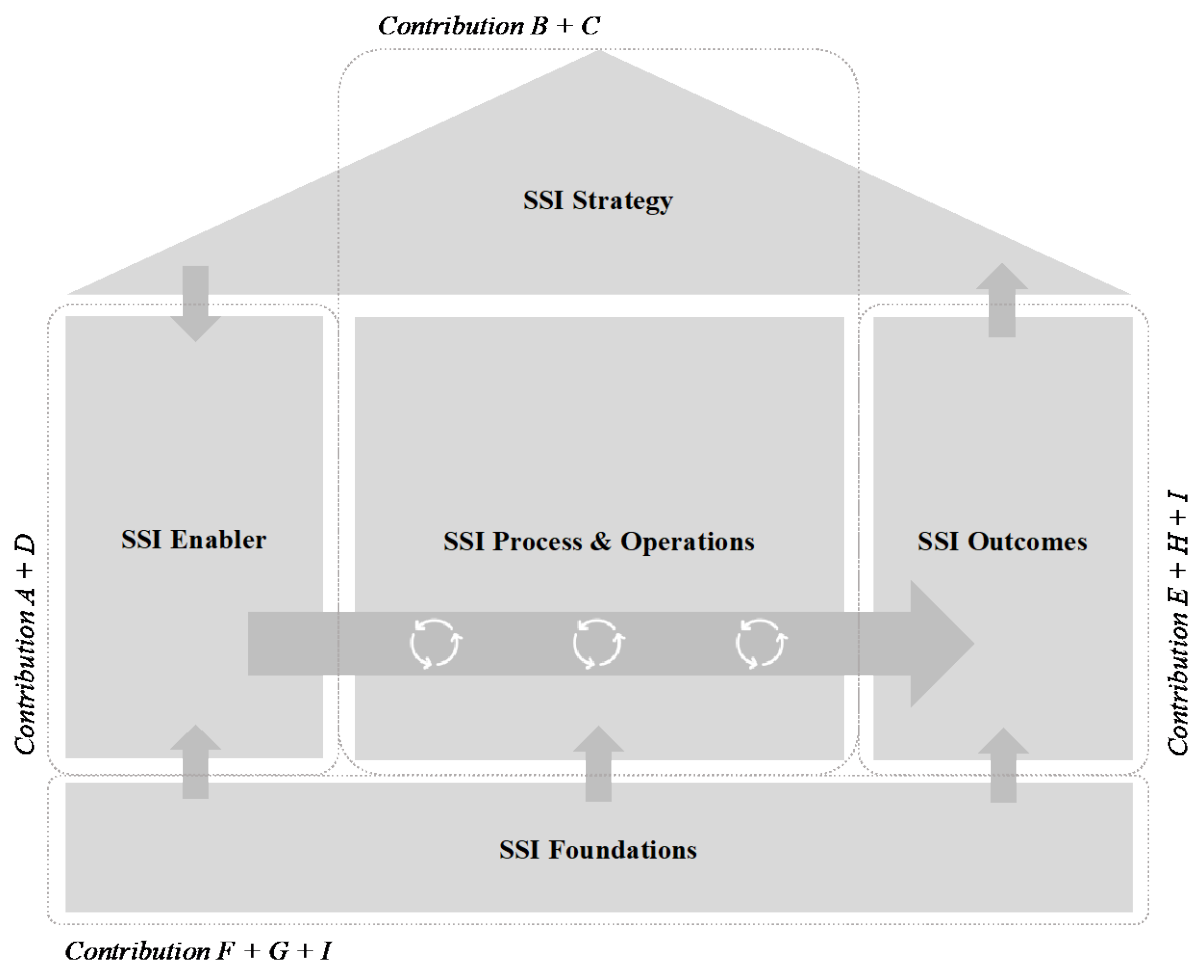
Figure 3: Strategic Service Innovation Framework

The SSI framework can be understood as the primary artifact of this dissertation. However, while each category within the framework is explained based on the research contributions, a number of existing concepts and methods from theoretical literature and practical innovation approaches are also incorporated. As this thesis focuses solely on the original generated data, links to existing concepts are discussed in Section 4.

2.3   Spectrum of Applied Methods

This dissertation follows a mixed-methods approach (Recker, 2013; Venkatesh et al., 2013, 2016)[2] because – in the given case of a cumulative dissertation – it offers certain freedom for

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[2] In this dissertation, we follow the suggestion of Johnson et al. (2007) to use the phrases "mixed-methods" and "mixed-research" synonymously

the researcher to choose the most adequate method for the single research projects on the one hand, combined with the broad acceptance and experience in terms of rigor inside the IS-discipline on the other hand (Lindner, 2020) seemed well-suited for the given research aim. Further, the intention of mixed-methods can even be explained with the school of thoughts in the ancient Greek philosophy, as described by Johnson et al. (2007):

> "Debates about singular or universal truths or approaches to viewing the world (Socrates, Plato), versus multiple or relative truths (the Sophists such as Protagoras and Gorgias), versus balances or mixtures of the extremes (…), go back, at least, to ancient Western philosophy (…). This debate continues to affect how we view knowledge, what we look for, what we expect to find, and how we believe we are to go about finding and justifying knowledge. We would position mixed research between the extremes Plato (quantitative research) and the Sophists (qualitative research), with mixed research attempting to respect fully the wisdom of both of these viewpoints while also seeking a workable middle solution for many (research) problems of interest" (p. 113).

From a micro-perspective, this dissertation represents the general paradigms of the IS research community. One paradigm aims to understand the behavioral questions behind the usage and non-usage of technology. The second paradigm focuses on engineering and designing new technologies (Hevner et al., 2004; Österle et al., 2011), as reflected in the prototypical research approaches. With two exceptions (Contributions G and H), this thesis presents design-oriented artifacts to contribute to both the scientific community and practitioners, offering tangible research outcomes that can be applied in practice as well as to new research projects.

To explore the IS research field, Contribution A built upon a broad perspective of the body of knowledge to identify gaps and define the research agenda and projects. Within the concrete domain of consulting, Contributions B and C built upon qualitative methods to discover potential new business models for consulting forms and to operationalize them. To calculate potential scenarios for a future platooning market, Contributions D and F included data from a Monte Carlo Simulation. In addition, prototyping was applied to the latter contribution, as well as a major artefact of contribution I. Finally, contributions G, H and I contained large-scale surveys (n > 1,000 for G and n > 2,000 for H and I). Table 3 provides an overview about the chosen spectrum of quantitative and qualitative methods.

	Research Method	Contribution									References
		A	B	C	D	E	F	G	H	I	
Quantitative Methods	Formal Deductive Analysis (e.g., Privacy Scoring Model)						x				Petkos et al. (2015)
	Simulation (e.g., Monte Carlo)			x	x						Wilde and Hess (2006)
	Survey							x	x	x	Göb et al. (2007); Likert (1932); Weiber and Mühlhaus (2014); Wilde and Hess (2006)
	Technology Acceptance Model (TAM)								x	x	Davis (1989); Pfeiffer et al. (2016); Xu et al. (2012)
Qualitative Methods	Case Study		x	x							Benbasat et al. (1987); Eisenhardt (1989); Miles et al. (2013); Paré (2004); Yin (2009); Yin (2013)
	Expert Interviews		x	x							Paré (2004); Yin (2009); Yin (2013)
	Other Qualitative Analyses (e.g., Content Analysis, Description, Cluster Analysis)							x	x	x	Mumenthaler (2009); Trang et al. (2020)
	Prototyping				x	x				x	Hevner et al. (2004); Peffers et al. (2007)
	Systematic Literature Review	x	x	x	x	x	x	x	x	x	Vom Brocke et al. (2009); Webster and Watson (2002)

Table 3: Applied research methods

3   Summary of the Research Contributions

3.1   SSI Strategy, Process and Operations

Like almost any service-oriented business, consulting firms faced the need for business model innovation (BMI) in response to digital transformation both within their own as well as clients' businesses (Krüger & Teuteberg, 2016; Nissen et al., 2017). The COVID-19 pandemic brought radical change to the consulting industry. Beyond the obvious switch from in-person to remote consulting (Nissen et al., 2017), new kinds of consulting and new types of consultants have found their way into the market. From technology-driven consulting firms in the context of digital business models, artificial intelligence or robotic, this radical change is a good example of the strategic impact of innovation within the presented SSI framework (see Section 4.2). While the overall goal of this thesis is innovation, in some cases – mostly for traditional companies – the way to innovative outcomes is through digital transformation (DT) to build novel digital services. Indeed, the original definition of DT, based on Zhu (2006), is innovation enabled through technology. Thus, the objective of Contribution B ("IT Consultants as Change Agents in Digital Transformation Initiatives") was to answer the following research questions:

   (i) Why do the (IT) consulting role models seem to vary in the context of DT initiatives?

   (ii) How does DT affect the scope and approach of consulting firms?

The multiple case study approach revealed that the innovative nature of consulting firms has several purposes. On the one hand, new services to address novel problems among clients need

to be developed. On the other hand, the consulting company itself might need internal innovation. Figure 4 presents this dual nature in an explanatory model along with the consulting cases [C] and derived propositions [P]. For the client, the requirements for DT projects can be explained from external and internal perspectives. Both perspectives might follow a digital maturity model determining the lever for DT and innovation. At the same time, the consulting firm needs to define the best-fitting approach, which is influenced by the corporate perspective (i.e., the consulting firm) and the individual advisors involved. The described factors will finally lead to a specific consulting role and deliverables.
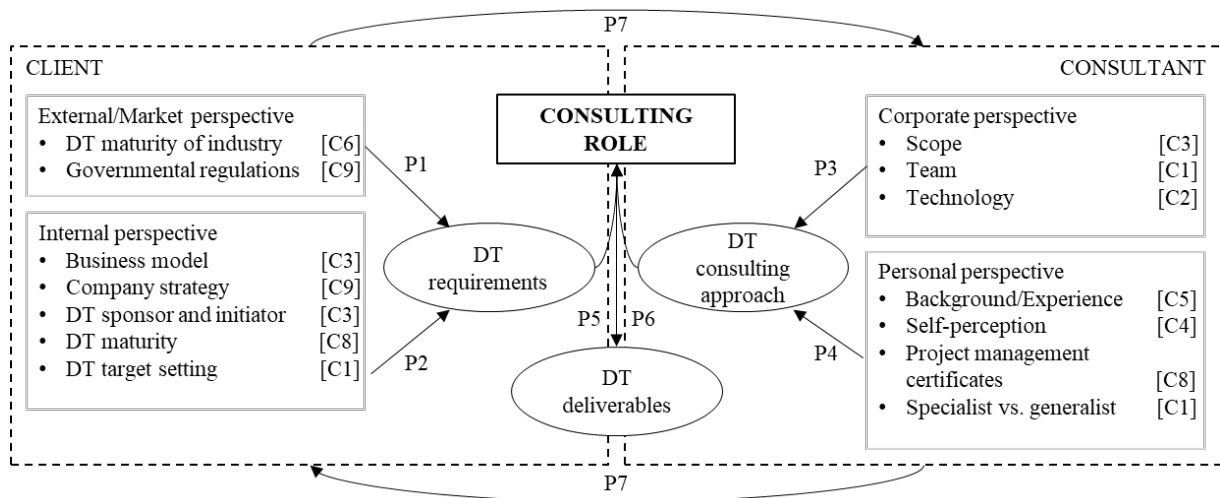

Figure 4: Explanatory model of DT key drivers for consulting (Krüger & Teuteberg, 2016)

Within the presented framework, Contribution A is an example of the connections between the different elements of the SSI house. The strategy of a consulting firm influences the search field of innovation and the approach to problem-solving. For example, a more organizationally driven consultancy firm would go for a change management approach, whereas a technology-driven advisory firm might choose a tool-based solution; a human-centered approach might include both by putting the client in focus without *selling* technology but instead utilizing it with a measurable value added for users. In this way, consultancies might overcome the risk of Technological Solutionism (Morozov, 2013) and create meaningful consulting approaches and value-creating innovations for their clients. Two major clusters of consulting firms were identified within the study, and both show a contradictory trend in their strategic scope. While IT consultancies include strategic advice to top management within their scope of service, strategy consultancies strive for technological competence and deep-tech competence (cf. Figure 5).
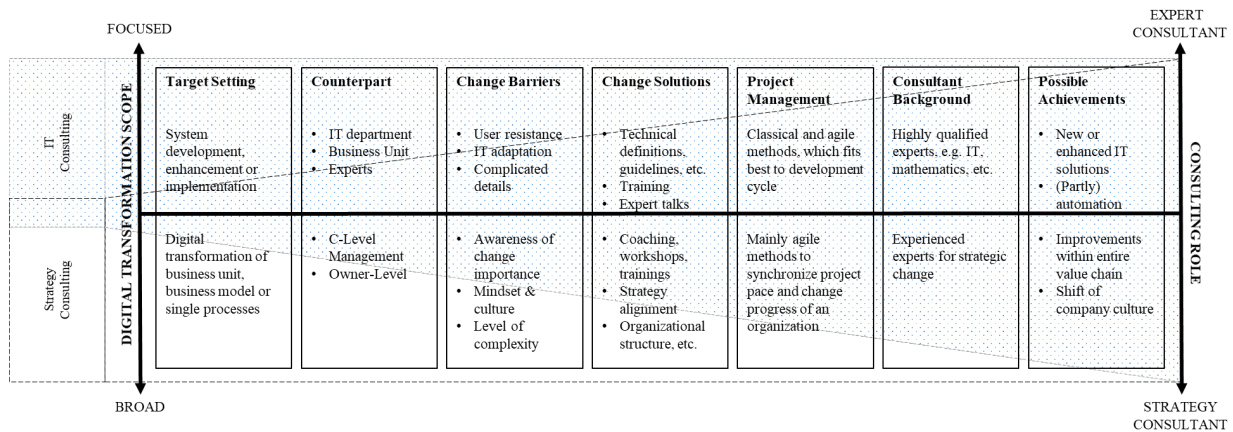
Figure 5: Switch of consulting business models (Krüger & Teuteberg, 2016)

This overlap effect of general consulting flight-levels has several implications for the process and operation layers of the SSI framework, which are outlined in Contribution C ("Consulting Business Models in the Digital Era"). The study was based on the following research questions:

(i) Which key-drivers for DT exist within consulting companies in general?

(ii) In a digitalized world, how could a business model for an IT and innovation focused consulting company look like?

As a major artifact, a Business Model Canvas (BMC) was presented. For this thesis, the value propositions are of high interest. Firstly, the achievements through external consultants will change. Instead of reports, analyses, and presentations, consultancies might follow the SSI framework within their operational structure by delivering value in the form of clear innovations in products or services. Secondly, sharing their own innovation culture and process with their clients will be established. Thirdly, building prototypes will be incorporated as a service for clients. Thus, a modern innovative consulting process could look similar to the overall SSI framework.

However, what matters for an innovative consulting project on a micro-level is also applicable to the consulting firm on a macro-level. Hence, the service innovation process of a consulting firm might also follow the presented SSI framework to generate new consulting services. In this regard, the importance of the presented link of all elements inside the SSI becomes evident. What seemed unfeasible for classical consultancies when Contribution C was published in 2018, became a game changer during the pandemic: remote consulting sessions (also known as virtualized consulting; Nissen, 2018). Those consultancies which adapted their business model technically and organizationally before the pandemic were already prepared for virtualized consulting. Thus, they were able to offer short online sessions or other adapted formats which are

not only a 1:1 transfer of offline formats. Finally, the evidence from these two Contributions B and C suggests that innovation and strategy are intricately linked within SSI.

3.2   SSI Enabler

The enabler for SSI may vary between data-driven sources, startup-scouting, technology-seeking, and so forth. These sources provide a solid base for the innovation process and valid data for the exploration of new ideas. With regard to Contribution A ("From Smart Meters to Smart Products: Reviewing Big Data driven Product Innovation in the European Electricity Retail Market"), the initial investigation was based on following research questions:

> *(i) How can change and product innovation management enable the effectiveness (e.g., in terms of cost-savings or additional turnover) of big data initiatives?*
>
> *(ii) Which change and product innovation management enablers (e.g., communication, transformation strategy and so forth) can be applied for smart metering within energy informatics?*

The European Parliament published a directive that was a de facto call for innovation for energy suppliers, stating, "In defining energy efficiency improvement measures, account should be taken of efficiency gains obtained through the widespread use of cost-effective technological innovations, for instance electronic metering" European Union (2006, §28). In this directive, which has to be adopted by all European Union (EU) countries, classical electricity meters will be phased out, and the new installations must be smart in terms of measurement (towards the end-user) and communication (to the provider and the grid). Derived from ranked journals and conference proceedings, the review of the body of knowledge revealed numerous action fields for practitioners and scientists that can be grouped into four different perspectives (technological, economical, organizational, and general). Understanding data-driven innovation as a core of potentially new strategic services is a major challenge for energy providers and energy informatics. With regard to the foundations in the SSI framework, data protection and privacy have been identified as another open issue. Privacy recently received much public attention as the Higher Administrative Court of Münster stopped the obligatory installation of smart meters due to problems with interoperability and security (BSI, 2021). Thus, the problem addressed in Contribution A proved to be true in practice but has still not been resolved by energy providers. A valid explanation for the shortcoming of a strategic paradigm shift in that branch might come from another finding of Contribution A, namely that traditional company culture and the energy supplier identity must shift to become a service innovation firm (PWC, 2015), again

representing the combinational dimension of the SSI framework. Punctual innovation has little effect; feedback at the strategy level of the company is necessary.

With regard to Contribution D, another enabler element has been identified. Taking the path to autonomous driving in the truck segment as an example, the contribution explores "Truck Platooning: Towards Future Business Models" based on two research questions:

> *(i) Which basic business models can be described for intra-fleet and inter-fleet platooning?*

> *(ii) How could a market for inter-fleet platooning look like, based on the current data available?*

Original platooning technology is defined as "coupling two or more vehicles without a physical link to form a train" (Royer et al., 2007, p. 294). On the one hand, this technology can be seen as a bridge technology to full autonomous driving. On the other hand, the concept of platooning might be a standard driving formation for virtually chained autonomous trucks to achieve additional fuel savings (Geiger, 2020).

While many technical as well as infrastructural questions drive joint international research projects, finding appropriate business models is also a major concern (Linné, 2020). For Contribution D, as no field data existed, a Monte Carlo Simulation was coded to create the data artificially in different scenario branches, taking realistic bandwidths for different parameters into account. The main concept of the contributions lives in a platooning app that shares the total realized savings of a platoon equally with all vehicles of the chain. This procedure might be a one-timer for longer route but could also happen many times when platoons merge, de-merge, and mix again. The mentioned parameters were calculated on a yearly level and cover an app fee (business model of the app itself, cf. Figure 6); a portion of trucks in Germany that are technically able to platoon; and an area where platoon formation is possible due to terrain, traffic, and routing.

— **1** — Optimized vehicle platooning via app service

⋯ **2** ⋯ Savings of following vehicles get summed up in the app

⋯ **3** ⋯ App calculates reward per vehicle in total fleet and allocates it to the drivers
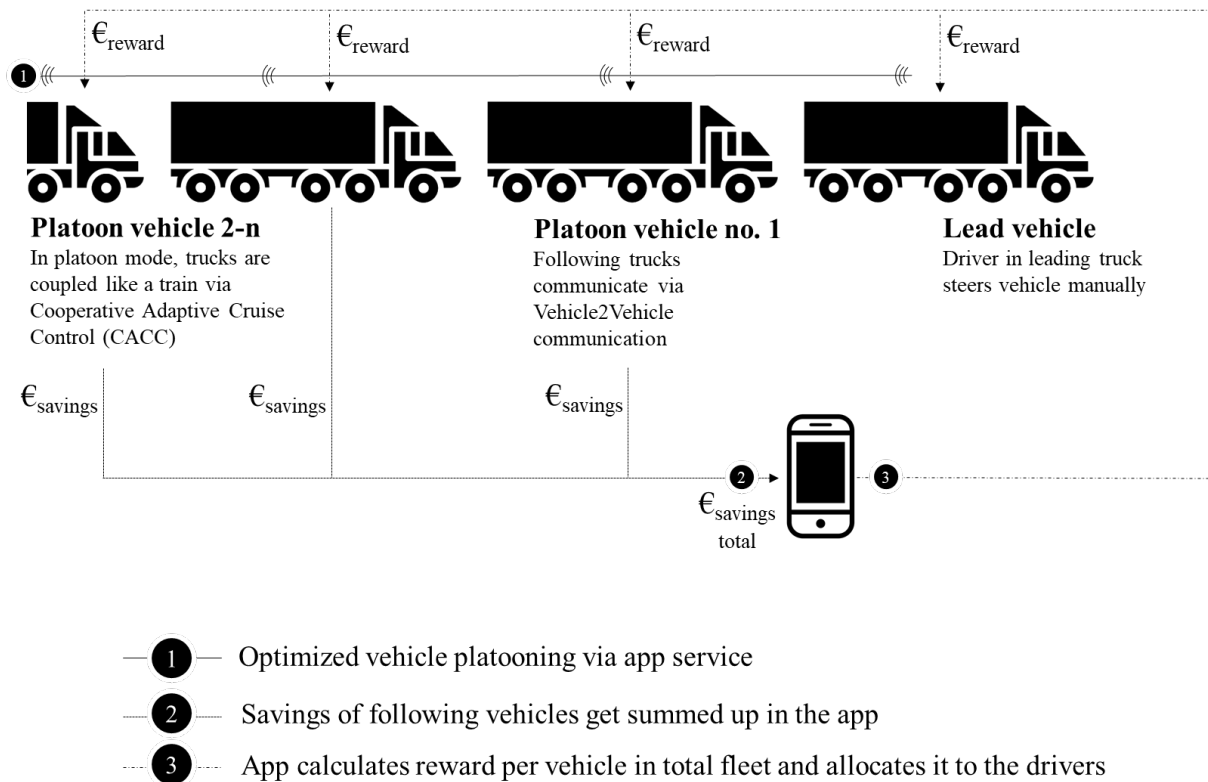
Figure 6: Scheme of a platooning app (Krüger & Teuteberg, 2018b)

Running the simulation 1,000 times, a variety of data was created and prepared for further analysis. While details are presented in the paper itself in Part B, the data shows an average potential savings in diesel across the entire German truck fleet of more than 201.94 million euros.

Linking this back into the SSI framework, Contribution D simultaneously explains different kinds of enablers at the same time. Firstly, technology-seeking and scouting are SSI enablers. While autonomous driving seems to be a popular topic in research, based on 77,100 entries on Google Scholar, only 18,800 research articles contain the keyword platooning.[3] Thus, this innovation needs to be scouted actively by interested companies. In practice, technology radars like the Gartner Hype Cycle[4] might be a concrete implementation of such technology-scouting methods and tools (cf. Section 4.2).

Finally, human centricity in the context of SSI enablers has two key components. Firstly, it is not necessarily the user or customer who represents the human factor; it could also be a new customer in a new market or use case scenario. Secondly, future employees can form the

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[3] The comparison was conducted with two individual search queries on Google Scholar:
https://scholar.google.com/scholar?hl=de&as_sdt=0%2C5&q=%22autonomous+driving%22&btnG= and
https://scholar.google.com/scholar?hl=de&as_sdt=0%2C5&q=platooning&btnG= accessed on 11th of March 2021

[4] Cf. https://www.gartner.com/en/research/methodologies/gartner-hype-cycle accessed on 11th of March 2021

human-centered aspect as both contributions underline the need for a change in company culture (i.e., from energy supplier to a data-driven service provider, from a truck manufacturer to a provider of a platooning platform), a shift in skills, and a shift in the technological field. Thus, a new question arises for organizations in terms of SSI enablers, which is: How can traditional companies move their focus from employees, customers, and users of the past to those of the future?

3.3   SSI Outcomes

The achievements of all explained innovation procedures in this dissertation are considered as SSI outcomes. It is therefore important to distinguish between output and outcome. While output is a metric that might be used within the innovation process itself, such as to measure the number of patents or publications, outcome is interpreted as the overall impact on an organization's growth and strategy (Dautovic & Pfannstiel, 2020). Two examples of this kind are presented in this Section. Contribution E, entitled "XPlatoon – Simulation and Prototyping of an intermediary model for truck platooning," represents a continuation of the discussed enabler of the previous Section and therefore of Contribution D. Based on the generated data, the Graphical User Interface (GUI) and User Experience (UX) were implemented in a prototype within Adobe XD as an interactive prototype. The research project was based on the following two research questions:

> (i) *Can the matchmaking problem in the context of platooning be solved by a platform provider and what economic potential does such a matchmaking business model offer?*

> (ii) *How can the incentivisation of platooning participants be solved fairly?*

The prototype (cf. Figure 7) elaborated the schematic concept of Figure 6 and had the aims of being as human-centered as possible and having a self-explanatory and slightly gamified GUI. Each driver has a personal XPlatoon profile that works as virtual wallet for earned rewards through platooning with other truckers. For the German truck market in particular, in which many truckers are a one-person logistic company, we assumed this is an attractive feature. Truckers can request a reward transaction to their bank account within the app. Most importantly, to find platooning partners, the start and endpoint of a planned route can be entered,

and a truck chain starts virtually. To include the vehicle individual parameters, the FMS inter-face can be used because all required parameters are part of that standardized truck interface.[5]
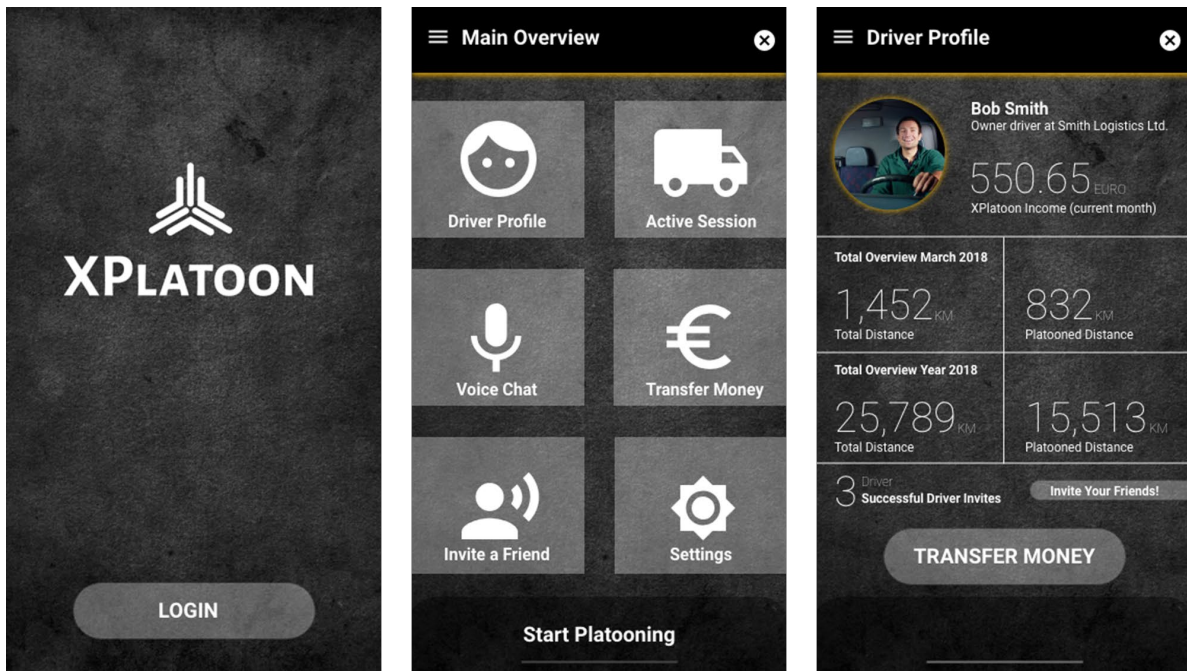

Figure 7: Exemplary XPlatoon prototypical UI[6]

Thus, the individual truck savings are calculated spontaneously. The leading truck does not achieve any savings but has the manual steering work and responsibility. As soon as a platoon formation ends, the trucker's reward can be calculated with respect to the weighted portion of savings generated by a given truck relative to the entire platoon. With respect to the leading vehicle, it is still an open issue how the involvement in the reward system needs to be designed to motivate truckers to lead a platoon. While this study focused on sharing savings, other factors such as being socially connected during a journey might also have an influence and could pre-sent an interesting anchor point for future research.

Another research objective was the German digital contact tracing solution, the Corona-Warn-App (CWA). Contribution H responded to the call for research (cf. Figure 8 below; Thomas et al., 2020) to develop ideas to cope with the pandemic from an IS perspective. Therefore, Con-tribution H was titled "Exploring User Acceptance Determinants of COVID-19 Tracing Apps to Manage the Pandemic" and sought to answer the following two research questions:

    (i) How can tracing and tracking apps be classified?

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[5] Cf. http://www.fms-standard.com/ for further information about the standard, accessed on 12th of March 2021
[6] An interactive live version of the prototype is available at https://t1p.de/xplatoon, accessed on 12th of March 2021

(ii) Which factors can improve the use intention and usage of corona tracing apps and in general social-participial apps?

To answer these questions, a survey (n = 2,398) was conducted with participants primarily from Germany and a further 29 countries. As mass acceptance of such apps is needed for a measurable reduction of infections – approximately 60% of the vulnerable citizens of a country (Hinch et al., 2020) – it is crucial to understand the human-centered factors of this technology. The open-source approach in German implementation of the joint proximity tracing framework by dominating operation system providers (Apple & Google, 2020) allowed a triangulation of our own survey data, comments, and issue reports on the code repository GitHub.

According to the SSI framework, the outcome of COVID-19 proximity tracing apps would be a decrease in infections. To better understand the different corona apps, a structural diagram of the apps was created (cf. Figure 8). The storage layer explains the need for the Apple-Google framework, which aims to offer a privacy-enhancing protocol. The second layer represents potential data input sources for the app, which are utilized in the fourth layer within an approach defining the overall scope of a corona application. The fourth and final layer describes the bandwidth of output formats found in existing COVID-19 applications. With regard to agile development practices like Scrum, it is worth mentioning that such an application scope is flexible and might change over time.
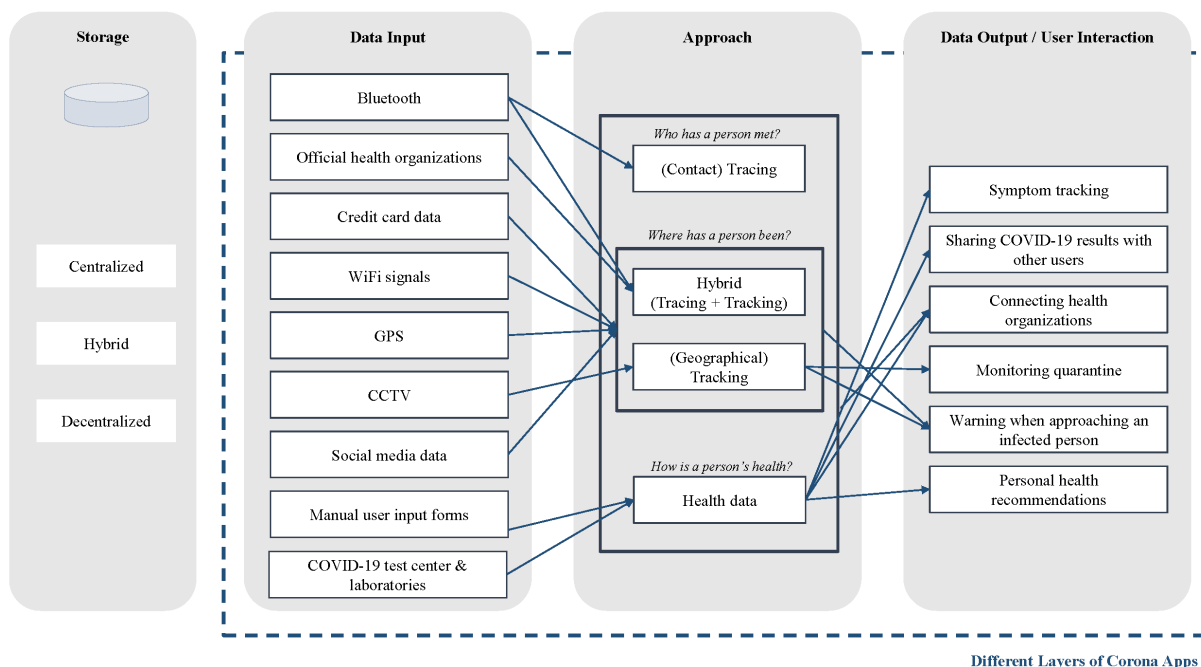

Figure 8: Structural diagram of COVID-19 apps (Krüger et al., 2022)

For the research model itself, we selected carefully adapted constructs of the Technology Acceptance Model (TAM) based on Davis (1989) and built nine hypotheses to test with a Partial Least Squares Structural Equation Model (PLS-SEM). As described, a crucial factor for fighting the pandemic is the actual use of a corona tracing app. To cover the international audience of the survey, we were only able to ask for usage (or non-usage) and the underlying reasons; a technical method to measure this item was not possible. Nevertheless, in combination with the open questions, insightful findings were gathered. The final model is presented in Figure 9. Overall, 81.11% of participants used their local corona tracing app. Four latent variables were found with a significant path coefficient for the intention to use (perceived usefulness, trust in technology, concerns about privacy, and anxiety about infecting others). We found that older people, women, and inhabitants of smaller residences use the app more often in comparison to other cohorts. In our dataset, the construct altruism matters more for male and older people.
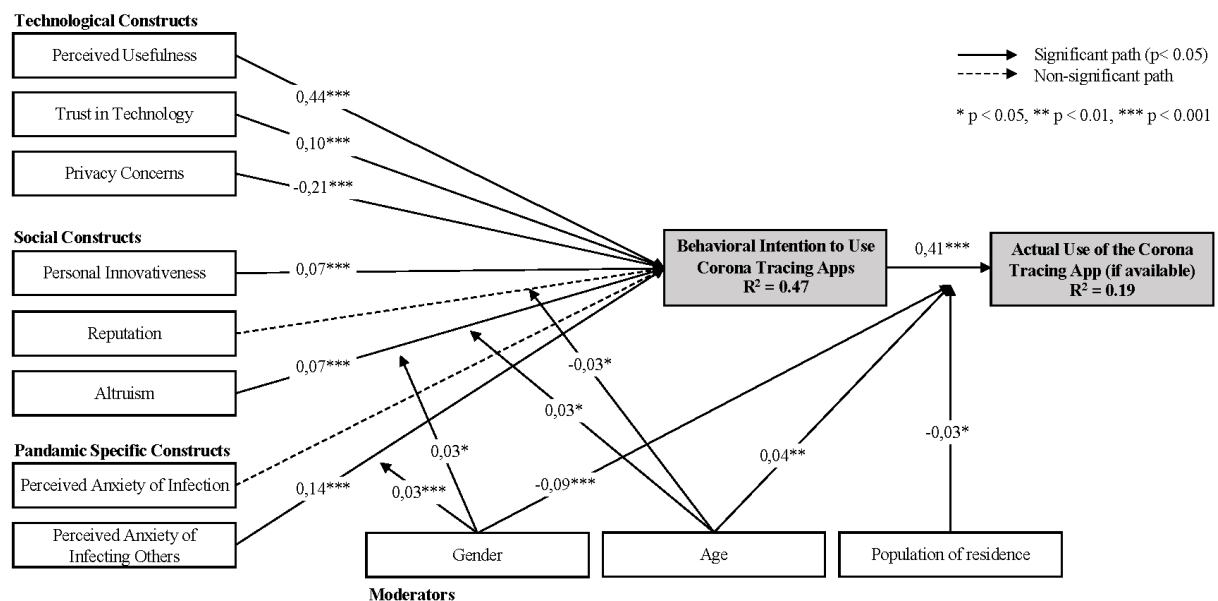
Figure 9: Final structural model (Krüger et al. 2022)

Regarding the human-centered design, perceived usefulness has the strongest path coefficient in the presented model; this is discussed further in Section 4.2 with regard to the ongoing development of digital solutions within the EU, such as a vaccine passport. In addition to the structural model, further findings were gleaned from open and supplementary questions. For instance, 97.25% of people who listen to scientific podcasts about the pandemic also use corona tracing apps. Interestingly, regarding the SSI framework, the most cited motivation for app usage is to overcome the crisis. To strengthen the human-centered paradigm in the model of

Trang et al. (2020), three clusters of COVID-19 app users (advocated, undecided, and critics) were extracted and enriched with further details from our own data set (cf. Figure 10).
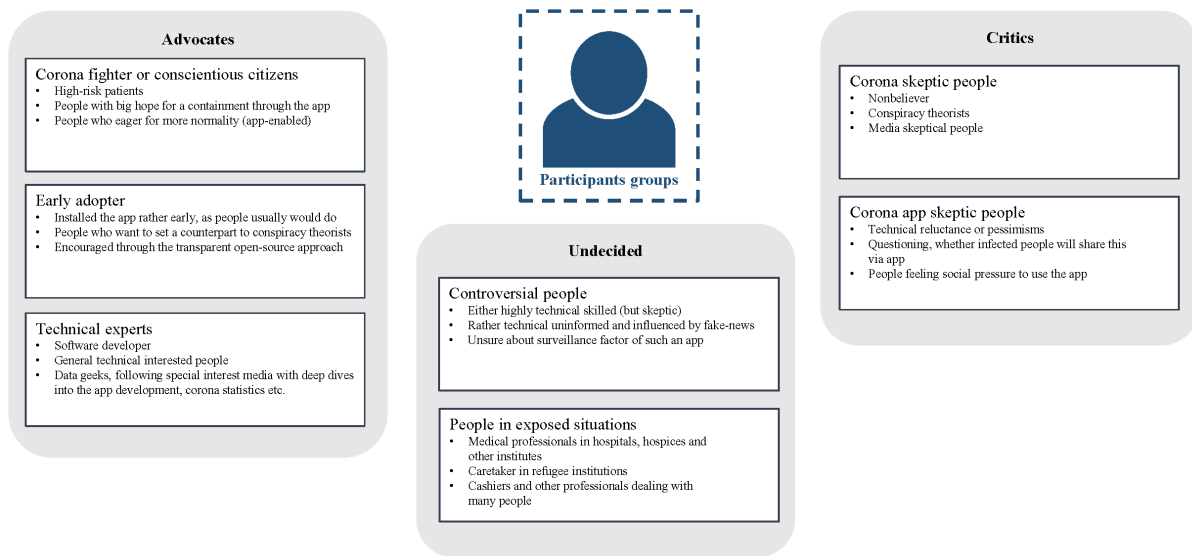

Figure 10: Enhanced core clusters of corona app user classification by Trang et al. (2020) with further in-depth details (Krüger et al., 2022)

Triangulating our findings with the opened issued on GitHub and the call for participation mentioned above, concrete propositions for future socio-participatory apps were generated for app makers. Contribution I, titled "Learnings from the design and acceptance of the German COVID-19 tracing app for IS-driven crisis management: A design science research", applied the previously described findings from a global to a local perspective, had to answer the following research questions:

(i)   Which design and functional elements of the German COVID-19 tracing app (Corona-Warn- App) should be enhanced to increase its acceptance?

(ii)   What lessons can be learned for applications in crisis management from the challenges of the Corona-Warn-App?

The German implementation of the Exposure Notification Framework (Apple & Google, 2020) represents a far-reaching SSI outcome in the understanding of this dissertation. This can be argued in the impact for the German health organization responsible for the app, the Robert Koch Institute (RKI). The German government ordered – via the RKI as the responsible government agency – the design and development of the CWA. The initially published user journey shows, from our today's understanding of the pandemical devolution, certain limitations. The non-iterative design process made it than awkward and tedious releasing new, epidemiological necessary, features. Our Design Science Research approach was quantitatively built on a sub-

sample of contribution H, which we enriched with qualitative statements and clusters for improvements which we took from (social) media and podcasts from experts in the virological field of SARS-COV2. Based on that first estimate of possible improvements, we formed an expert group out of IT- and health experts to gather feedback. In two steps, UX-oriented and functional improvements were collected and conceptualized in a prototype (Behne et al., 2021). Finally, another user-testing with more than 50 participants provided data for 13 potential frontend improvements and six backend-enhancements. Additionally, we were able to update the initial user journey to the current state of the pandemic. Beside the findings of contribution I might be supportive for the concrete enhancements of the CWA (some of our recommendations can be found in the newest updates the CWA at the data of publishing this dissertation), we were able to generate some general learnings for the design and acceptance of crisis-related applications (see section 3.4).

3.4   SSI Foundations

The foundations of the presented SSI framework (cf. Figure 3) represent required baseline processes for innovations. Under the influence of the pandemic, the development of the German CWA is a valid example of broad risk management for data privacy, privacy by design, or continuity management (Cho et al., 2020; Kaptchuk et al., 2020). A generalized question behind privacy-related aspects is the degree to which users are aware of potential privacy concerns when using new digital technologies or, in contrast, how much users are negatively influenced and feel threatened by non-existent risks. Again, the CWA is a popular example of this ambivalence within a given society.

Contribution F analyzed the de-facto privacy awareness of smartphone users by computing an individual privacy score per user based on several factors related to social media and mobile networks. The paper, titled "The Black Mirror: What our Mobile Phone Number tells about us", asked the following research question:

Which requirements and implications arise for social media and mobile phone privacy from a privacy scoring model (PSM)?

To answer this research question and to compute the PSM, an existing PSM framework (Petkos et al., 2015) was adapted based on privacy factors derived from literature, including potential privacy threats for the mobile network layer and for social media apps. This approach was new as most attack vectors focus solely on one layer (network, device, or application). However, as

more and more cases of data linking based on personal phone numbers have been revealed and an increasing number of applications use phone number as an identifier, this approach seemed promising for the research goal. Thus, 1,000 random phone numbers were created to test the PSM by analyzing which and how much data could be scraped. For ethical reasons, we computed the PSM and did not save the generated user data itself, such as when a mobile phone number could be matched with a person from social media or a messenger profile. Figure 11 presents the final PSM model with the three dimensions we were able to link to each user, which is commonly known as the fingerprinting approach (Herrmann, 2015). Beginning with the network layer, we found the home location register (HLR) to be a promising source for initial privacy attack vectors because the status (that is, whether the phone is on or off) and roaming of any number can be checked with minimal technical effort. We identified and analyzed 1,000 existing phone numbers, looked up existing profiles on different social platforms, and were able to utilize WhatsApp and Facebook as further anchor points.
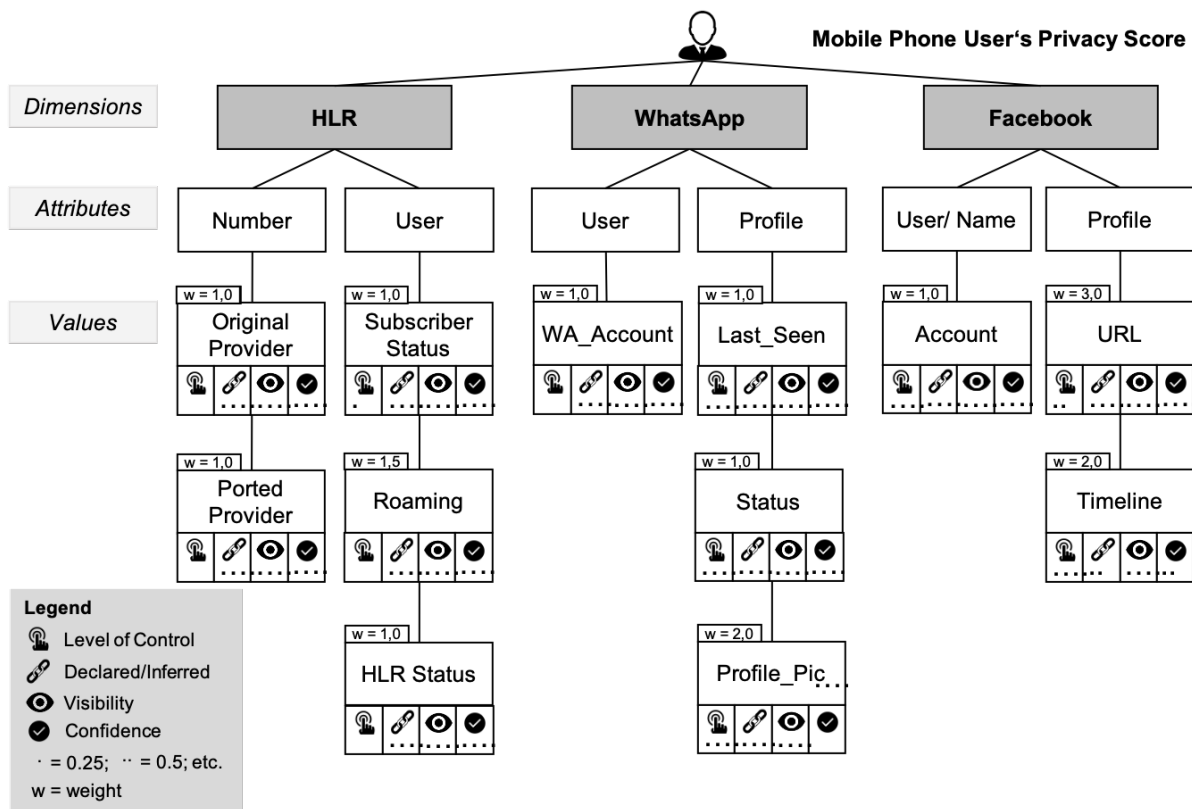
Figure 11: Applied PSM model for mobile phone privacy (Krüger et al., 2020)

We showed that open-source intelligence (OSINT) is indeed a threat for new technologies, especially for online social networks (OSNs) and smartphone applications that use mobile phone number as a personal identifier. From the broader perspective of fundamental privacy risks, the SSI framework contains this as a general finding for service innovation. As many services are

provided in smartphone applications, the question of data linkability is highly pertinent. For example, distance learning might be understood as an SSI for educational institutions necessitated by the pandemic. Many children (or students) use WhatsApp communications with their teachers to engage in distance learning. However, for such an SSI, WhatsApp might not be a good choice due to the linkability of personal profiles. A mobile phone number alone is sufficient to launch privacy attacks on social media accounts or even sleep rhythm (by scraping online and offline times over a long timeframe of a single WhatsApp user).[7] In addition to the PSM itself, UI elements of a privacy-checker were developed and published (cf. Figure 12).
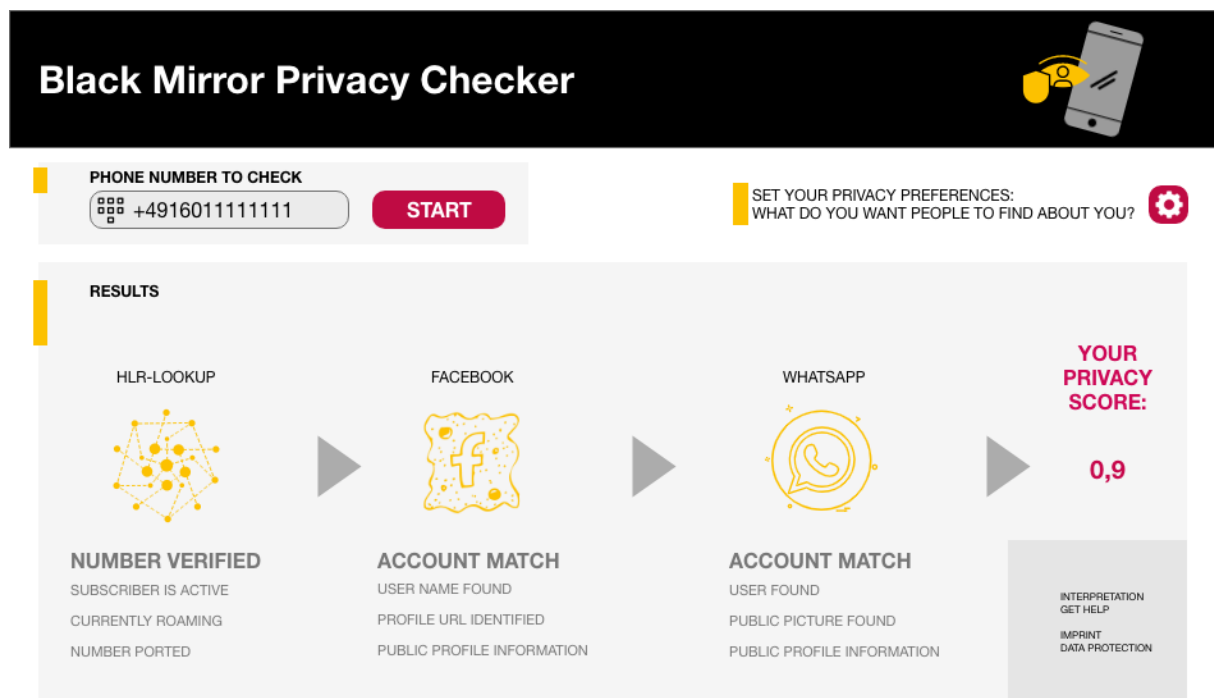

Figure 12: Prototype of a Robot Process Automation implementation as single-page web application frontend (Krüger et al., 2020)[8]

A second micro-element is learning capability. In academia, striving for new knowledge and permanent learning are logical and foundational elements. In contrast, the traditional goal of business administration is profit maximization, which is increasingly discussed in the research community (Friedrich, 2012; Ulrich, 2009). Thus, generating insight and creating a learning organization is a radical component of modern management approaches and the highest level in the agile maturity scale (Andresen, 2019). Practical workshop formats like working out loud

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[7] See https://www.onlinestatusmonitor.com, accessed on 25th of March 2021

[8] The most recent version of the prototypical UI is available on GitHub, cf. https://github.com/swinging-code/bis2020_blackmirror, accessed on 18th of 2021, and might be developed further in future research projects, especially regarding an interactive version

(WOL), lernOS, and – as analyzed in Contribution G – hackathons can create contemporary learning conditions. The history of hackathon events goes back to live coding events, which were first initiated to introduce new applications for the Palm Handheld OS in 1999 (Aviram, 1999). Today, hackathons are (remote) co-creation events with interdisciplinary teams from software development and design (Feldmann & Teuteberg, 2019) as well as business and strategy (see Section 3.1). Due to the COVID-19 pandemic, the German government initiated the #WirVsVirus hackathon event. Thus, Contribution G, "Are Hackathons the New e-Learning Environments? On the Outcome of the #WirVsVirus Hackathon From a Learning Outcome Perspective" was based on the following research question:

To which extend do hackathons foster digital learning outcomes?

Generally, organizations choose hackathons for specific innovation endeavors (Feldmann & Teuteberg, 2020). Although the #WirVsVirus hackathon brought 25 of 1,500 initiates in any form of concrete spin-off structure, e.g., by founding a Ltd. Company or GmbH in Germany, the qualitative interpretation of a survey among the participants (n = 1,499) led to the conclusion that such a remote hackathon event can generate substantial knowledge within the interdisciplinary teams. According to a self-selected challenge, each team had to manage a social as well as entrepreneurial encounter, i.e., the organization of the team structure, the needed skills, execution of the prototype and the legal, strategical and marketing-related questions. The survey indicated that non-technical participants in particular made substantial learning progress during the event despite not expecting to learn anything. Participants noted this intense learning regardless of personal background and prior knowledge. Furthermore, the long-term (learning) effects might be even more intense as many teams have continued working to launch a fully designed service. In total, we were able to build four learning-related clusters (collaboration, diversity, prior knowledge, and learning curve) based on participants' feedback.

Further SSI Foundations have been generated in contribution I, which was introduced in the previous section already. Thus, we were able to identify meta-requirements and design-principles for future pandemic apps. As vaccination appointment apps, vaccination passports, checkin-apps and so forth face continuous demand, scientific groundwork matters in that field. One major learning here is a shift in the operating model for government agencies from linear (or classical) app development to agile (or iterative) practices. Traditional requirement engineering techniques are not capable of handling the rapid development of pandemic, global waves, which require permanent adjustments on back- and frontend level. Contribution I clustered these adjustments in a SCRUM-oriented way: User Stories have been used to describe

single features from a human-centered perspective. This approach supports a user-driven design process and feature setting. Then, several user stories were combined in broader epics. Such an approach should be combined, as already mentioned with regard to contribution H, with an open-source strategy, which might be a fundamental paradigm shift for some governmental agencies and the connected providers, but which strengthens the acceptance and trust into pandemic apps significantly (Behne et al., 2021).

4 Discussion

4.1 Implications for Research

Consulting research (Nissen, 2007) is tackling the transition of consulting services into new, remote formats (RQ 1) now more than ever, as examined in Contributions B and C. The roles of consultants have evolved under the influence of two factors: the requirements for digital solutions on the client side and the digital maturity of the consulting firm itself, which determines scope and approach. The presented transition of the consulting scope from IT to strategy and from strategy to IT as well is not a surprise from an IS-driven perspective. As an added value, other disciplines might benefit from an understanding of the interdependencies between business and technology advising. Regarding the key drivers of DT, Contribution C provided three dimensions of DT in the consulting research context. Based on these dimensions, cornerstones for new business models in the consulting field were presented. However, this research field is permanently evolving. While the scientific impact is presented in the BMC, Section 4.2 discusses concrete practical implementations.

Contribution A strengthens the end-user orientation in energy informatics as scientific evidence for far-reaching use cases of smart metering are still rare (RQ 2). The need for a data-driven perspective in SSI was identified as an important enabler in Contribution D.

The characteristics of human-centered SSI (RQ 3) were demonstrated in Contributions E and H and are at least somewhat exemplary. Taking platooning as a technological example of a visionary solution for intermodal logistics, research might build upon the concept for end-user-oriented service design. Contribution H offered several implications for research, the most dominant of which is the understanding of user acceptance of SSI. The urgency of the pandemic has rendered the acceptance of several new technologies by a broad audience necessary. This dissertation contributes by outlining concrete acceptance criteria that were empirically generated

for socio-participatory health applications. Future applications of this kind might combine the achievements of this dissertation and other publications by designing solutions for corona location check-ins or digital vaccination reports (Meier et al., 2021). Beyond that, researchers can benefit from these findings, e.g., by the importance of scientific podcasts, their role in understanding interrelations of app usage and knowledge. It might also encourage scientists to communicate to the public via modern platforms and channels, which is basically a requirement of the DSR approach as a final important step, as described by Peffers et al. (2007).

With regard to RQ 4, the current halt of smart meter rollout by the German courts indicates the impact privacy has on user-level holds. Privacy concerns need to be at the core of complex innovation processes. As Contributions F and H stressed, including end-users in a modern, human-centered way also means following a privacy-enhancing design to avoid any loss of acceptance.

By providing a strategic perspective and linking with a company's strategy, the direction for innovation might be clarified. Furthermore, human centricity can enrich disciplines like RE with evidence-based innovation formats. Design Thinking, as an exemplary holistic method of human-centered design, might become an increasingly important part of future academic research (Vogel et al., 2020). Moreover, hackathons are a valid innovation format with huge potential for corporate learning as well as for academic teaching, representing an inspiring environment for integrated service learning (Keders et al., 2019) at the intersection of science, technology, engineering, and mathematics (STEM[9]) and business-oriented curricula.

On a broader scale, the contributions have added to the body of knowledge in the field of service innovation and associated research. While several examples of concrete elaboration within the SSI were discussed along the contributions, the existing body of knowledge already offers many elements that could be subdivided into the SSI as needed in a certain context. Researchers might take the framework further by enriching it with enhanced elements. Finally, this dissertation is in line with the findings of human-centered artificial intelligence faculties at Stanford University and the Massachusetts Institute of Technology as well as the worldwide SUGAR research initiative, underlining the scientific focus on integrating human centricity into the design and development of technology.[10]

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[9] The German equivalent in education is known as *MINT* (Mathematik, Informatik, Naturwissenschaft und Technik)

[10] Cf. https://hai.stanford.edu/ and https://mitsloan.mit.edu/ideas-made-to-matter/how-can-human-centered-ai-fight-bias-machines-and-people as well as https://sugar-network.org/about/, accessed on 15th of March 2021

4.2   Implications for Practice

The selected contributions underline the necessity for a strategic anchor of an organization's innovation process into vision, strategy, and – most importantly – the early involvement of users to enable human-centered innovation. Overall, the insights offered into SSI are comprehensive and can inform implementation of this approach in an organization, although the discussed micro-elements of the frameworks represent only a selection; further elements are thinkable and might be added in future research projects. To operationalize the framework, practitioners must determine how to make an organization capable of managing the elements of the framework.

Contribution A strengthens the human-centered perspective in two ways. Firstly, it addresses the need for change management in a classically structured organization. Secondly, transforming a traditional company (in this context, an energy supplier) into a service-driven innovator is a huge endeavor that requires the upskilling of existing employees or new job profiles. German start-ups like intuity[11] or Quantum[12] may represent valid learning objectives and best practices here because these companies are service-driven software companies focusing on human-centered, rapid innovation. The traditional business of energy supply is a commodity that digitalization builds upon. As such, an interesting possibility arises: Energy companies can make better use of (internal and/or public) hackathon events not only to come up with fresh ideas but – as shown in Contribution G – to enhance the skills of existing teams in data science and business model innovations. Furthermore, hackathons, as a co-creation-format, have many positive implications on human resource management and strategy (Engelsberger et al., 2021).

The practical findings and implications for Contributions D and E show concrete steps for a service-induced market for platooning. Blockchain technology presents further potential, as recent research suggests (Jeong et al., 2021; Singh et al., 2020). Thus, the presented XPlatoon prototype might encourage automotive or fleet managers for a proof of concept with existing platooning hardware to create an integrated platooning solution in the mid-term future.

Given that consultancies must enact permanent adaptions to their advising field, the findings of Contributions B and C could inform the necessary blend of strategy and IT consulting. The aspect of human centricity is no longer unknown in the consulting field, as Gartner showcased

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[11] Cf. https://www.intuity.de/branchenexpertise/energiezukunft/, accessed on 15th of March 2021
[12] Cf. https://quantum.de/, accessed on 15th of March 2021

in a recent whitepaper.[13] Moreover, consulting companies increasingly include the needed skills for SSI in their training for consultants (Krüger & Teuteberg, 2018a). Additionally, building consulting capabilities in the digital field is omnipresent in the consulting field, in some cases via specialized subsidiaries.[14] Truck platooning, for instance, might be beyond the scope of a traditional strategy consulting study because such a novel technology is more in the field of a technology consulting firm, such as Gartner, Inc. However, based on the contributions and the author's practical experience in consulting and automotive technology, an approach that includes technology constitutes a new consulting field.

With regard to Contributions F and H, privacy is highly relevant for service innovations, as reflected by the current debate about new approaches to pandemic containment via location check-ins. It is clearly recommendable to reveal the source-code of apps like Luca on open-source platforms.[15] Thus, the start-up culture4life would clearly benefit from the SSI by linking the implications of the privacy foundations with their overall strategy. On the other hand, this approach might harm their current business model, again demonstrating that SSIs are an iterative process with a massive impact on a company's overall strategy.

To conclude, human centricity might have a positive impact on the embrace and design of SSI in corporations. However, practitioners might choose to include all SSI perspectives when implementing innovation processes in their organizations. While focusing only on the innovation process itself might be too narrow, an unoriented hype of agile practices might also be misleading as many underlying concepts – such as iterative user feedback – have been part of standardized service innovation methods for years (ISO, 2021; Thomas et al., 2008). Moreover, an inclusive perspective of user needs (human centricity) in the innovation process is recommended. The overall organizational perspective (strategy), underlying scientific theories (foundations), and important but often neglected innovation aspects like privacy or risk management need attention. Enablers of a different kind be they start-ups, technology scouting, data science, and so forth, should be planned and budgeted for even without short-term output. The

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[13] The wording "people-centric" is used by Gartner as a synonym for human-centered, cf. https://www.gartner.com/smarterwithgartner/gartner-top-strategic-technology-trends-for-2021/, accessed on 17th of March 2021

[14] For instance, McKinsey & Company founded McKinsey Digital (cf. https://www.mckinsey.de/funktionen/mckinsey-digital, accessed on 18th of March 2021), Deloitte brought Deloitte Digital to the market (cf. https://www.deloittedigital.de/en.html, accessed on 18th of March 2021), and zeb even created a digital hub for human-centered design and rapid prototyping with tabularaza (cf. https://tabularaza.zeb.de/, accessed on 18th of March 2021)

[15] Cf. https://www.heise.de/news/Luca-App-Mecklenburg-Vorpommern-beginnen-mit-Kontaktverfolgung-5987369.html, accessed on 15th of March 2021; it is noteworthy that an original idea for privacy-enhancing events and location check-ins was published by a group of IT security researchers via GitHub as reference architecture: https://github.com/CrowdNotifier/documents, accessed on 15th of March 2021

longitudinal view of multiple outcome formats seems to be a promising path towards substantial service innovation.

4.3   Limitations and Future Research

The contributions of this dissertation went through multiple reviews in the scientific IS community using the double-blind peer-review approach to ensure the quality of each publication. While the relevance of each contribution is derived from current research and practical problems, the question of rigor depends on the method applied (e.g., Dubé & Paré, 2003) for rigor in case research; Österle et al. (2010) for a general discussion on rigor and relevance in the field of IS). This is especially true for the mixed-methods approach used in this dissertation. Therefore, the individual limitations of each contribution are presented below, along with a summary of limitations of the overall research project and suggestions for future research projects.

For all contributions, one limitation is language bias (Morrison et al., 2012; Rasmussen & Montgomery, 2018) during the process of literature research. Focusing on English and German publications restricted the researcher's perspective to work from these linguistic environments. Contribution A, as a systematic literature review, must be interpreted in light of this limitation. The chosen case study approach in Contributions B and C faces two similar limitations. Firstly, by selecting case study partners from Germany and Switzerland only, language as well as cultural bias might exist. In the context of change management, which is an important element of both contributions, cultural influences might have an effect on the contributions' results that could be worth consideration in future international studies.

With respect to the simulation-based Contributions D and E, the parameterization of random variables was based on realistic ranges at the time of project completion. However, these ranges might vary with the evolution of the investigated innovation (e.g., the number of vehicles which can form a platoon or potential diesel savings) and may hold more complexity in practice as computed in the simulation. Thus, such a simulative model can only be a simplified reality under the given restriction of the assumptions of the researcher.

Contribution F is limited by its local applicability because only phone numbers from Germany were used. Another limitation is the purely technical view of the problem without active involvement of the user. From a behavioral IS perspective, reproducing the PSM in combination with a user survey could generate findings about perceived privacy on an individual user level. With regards to Contribution G, the ex-post access to the dataset represents a limitation. Although several research teams received the data dump of the #WirVsVirus organizers, which

strengthens objectivity and reliability, an active part as a researcher in designing and conducting the survey would have increased accuracy.

5 Conclusion

This dissertation aimed to investigate service innovation characteristics in terms of their strategic alignment within an organization and level of human centricity in the innovation process. As a main artifact of this dissertation, the created SSI framework is a comprehensive high-level framework that can be populated by researchers and practitioners in relation to their given context. The cumulative format of this dissertation contains eight contributions, each guided by a certain aspect of the SSI in a broader social- or business-related context. How the consulting field might evolve in the Digital Age was the research objective of two contributions. While these two articles were developed before the pandemic, the discussed findings and challenges have undergone dramatic acceleration since remote work became the norm under lockdown situations. In contrast to the trivial digitization of services, human-centric SSI strive to achieve a much higher level of maturity, as clarified in the last contribution investigating the acceptance of corona tracing applications.

In all four domains covered by this thesis (energy supply, COVID-19, consulting, and truck logistics), major changes in the business model are the consequence of SSI. Thus, SSI outcomes should not be interpreted as incremental innovation or be underestimated in terms of their long-term impact on business strategy: Their disruptive or radical momentum justifies (re-)integration into the overall strategy and a firm's business development path.

Foundation-related SSI elements and contributions illustrate privacy (by design) and continuous learning (also known as upskilling) within innovation processes. Furthermore, the findings of the hackathon format matter for industrial practitioners as well as for the educational sector. The intense learning experience during a hackathon for all participants fosters innovation and presents a steep learning curve that might generate additional ideas.

To conclude, one of the main concepts of the SSI framework – in contrast to other more funnel-oriented innovation processes – is the evidence, that the creative output within the SSI framework increases over time. For this reason, Design Thinking involves phases of diverging and converging in which more ideas evolve over time, while RE processes tend to have a more convergent nature (Hehn, 2020).

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Part B: Research Contributions

Contribution A: From Smart Meters to Smart Products: Reviewing Big Data driven Product Innovation in the European Electricity Retail Market

Authors	Krüger, N.; Teuteberg, F.
Year	2015
Outlet	Informatik 2015 Proceedings
Identification	ISBN 978-3-88579-640-4
Online	https://dl.gi.de/handle/20.500.12116/2181
Status	Published
Full Title	From Smart Meters to Smart Products: Reviewing Big Data driven Product Innovation in the European Electricity Retail Market
Short Title	From Smart Meters to Smart Products
Abstract	This paper tries to provide a perspective on energy informatics that goes beyond solely technical research. Combining the viewpoints of energy informatics and information systems in a review of top-ranked literature, we aim to start the discussion how to bridge the gap between a technology-driven focus on big data possibilities (such as smart grid, smart metering, etc.) and a business model-driven perspective (innovation, price-reduction, CRM, etc.). With this paper we further underline the necessity of an interdisciplinary research approach and try to investigate a value chain-oriented implementation of big data initiatives. Especially in the European electricity branch, big data – in terms of smart metering – seems in some cases to be implemented in order to fulfil governmental regulations. CRM as well as corporations' change management has been</br></br>neglected. By conducting a structured literature review, the status quo of smart meter related big data (initiatives) in energy informatics and information systems will be discovered, and a research agenda for further research in this area will be provided.
Keywords	Big data, change management, big data implementation, smart metering, smart grid, energy informatics, data-driven business, data-driven innovation

Contribution B: IT Consultants as Change Agents in Digital Transformation Initiatives

Authors	Krüger, N.; Teuteberg, F.
Year	2016
Outlet	MKWI Proceedings 2016
Identification	ISBN 978-3-86360-132-4
Online	https://www.db-thueringen.de/receive/dbt_mods_00027211
Status	Published
Full Title	IT Consultants as Change Agents in Digital Transformation Initiatives
Short Title	-
Abstract	Digital transformation (DT) is a broad field for IT and strategy consulting companies. It requires a special mixture of cross disciplinary competences and experiences. While pure IT consultants find themselves progressively in new situations of organizational change or ethical considerations (e.g. autonomous driving), strategy consultants are asked more often for support in technological problems. IS literature has elaborated socio-technological concepts, but in terms of DT those models leave an open point regarding ideas to boost a complete digital shift of a corporation. This paper tackles the role model and skill shift of consulting firms with a multiple case study. We included well-experienced companies of the DT field and found why and how IT and strategy consultants can learn from each other to handle DT. Based on our case study findings, we provide a model for IS researchers and draw pragmatic recommendations for consulting firms.
Keywords	-

Contribution C: Consulting Business Models in the Digital Era

Authors	Krüger, N.; Teuteberg, F.
Year	2018
Outlet	MKWI Proceedings 2018
Identification	ISBN 978-3-935786-72-0
Online	https://mkwi2018.leuphana.de/programm/tagungsband/
Status	Published
Full Title	Consulting Business Models in the Digital Era
Short Title	-
Abstract	Consulting research and consulting practice needs to think beyond digitalization. Consulting business models for a digital ecosystem are requested but can rarely be found in the relevant literature and the market. Coping with legacy systems and shifting historical strategy decisions is still on the agenda of many consulting projects. This paper aims to deliver a scientific building block to the consulting business by exploring the consulting processes and methods in the digitalized age. Based on semi-structured interviews with different kinds of consulting firms, a multiple case study has been designed. As our research shows, Digital Transformation has a substantial impact on consulting research and consulting in practice. Both have to be reconsidered in the digital context, for instance concerning business models, science and data-driven methods or rapid prototyping. The authors aim – practically - to deliver a Business Model Canvas for future consulting and to create an explanatory model for the information system-centric perspective on business model research.
Keywords	Digital Transformation, Consulting Research, Business Model Innovation

Contribution D: Truck Platooning: Towards Future Business Models

Authors	Krüger, N.; Teuteberg, F.
Year	2018
Outlet	MKWI Proceedings 2018
Identification	ISBN 978-3-935786-72-0
Online	https://mkwi2018.leuphana.de/programm/tagungsband/
Status	Published
Full Title	Truck Platooning: Towards Future Business Models
Short Title	-
Abstract	Automated driving trucks promise significant improvements with regards to traffic, logistic costs and emissions. Platooning can be seen as the next technological step in this direction. While the body of literature reflects the engineering perspective of platooning extensively, an Information Systems discussions about user-centered business models are rare. Our paper aims to strengthen the Information Systems perspective on platooning and its inherent business models. Up to the current state of our project, we found that intra-fleet platooning can be understood as an amortization issue, while inter-fleet platooning requires complex matching algorithms, motivational incentives for drivers and fleets and easy plus fast payment solutions. We built a Monte Carlo simulation for an inter-fleet platooning app and present preliminary results.
Keywords	Platooning, Autonomous Driving, Logistic Research, Logistics, Vehicle2Vehicle Communication

Contribution E: XPlatoon – Simulation und Prototypisierung eines Vermittlermodells für LKW-Platooning

Authors	Krüger, N.; Teuteberg, F.
Year	2019
Outlet	BUIS 2019 Proceedings
Identification	https://doi.org/10.1007/978-3-658-25210-6_7
Online	https://link.springer.com/chapter/10.1007/978-3-658-25210-6_7
Status	Published
Full Title	XPlatoon – Simulation und Prototypisierung eines Vermittlermodells für LKW-Platooning
Short Title	-
Abstract	Die elektronische Kopplung von LKW (Platooning) erlangt in Forschung und Praxis zunehmend Aufmerksamkeit. Pilotprojekte im realen Straßenverkehr finden in zahlreichen Ländern statt und wichtige Testkilometer werden gesammelt. Doch jenseits technisch motivierter Fragen existieren zahlreiche nahezu unangetastete Forschungsgebiete an den Schnittstellen zwischen Technologie, Ökonomie und Gesellschaft. Zahlreiche Publikationen weisen auf das bislang ungeklärte Problem der Platooning-Geschäftsmodelle hin. Das vorliegende Paper versucht eine mögliche Antwort auf diese Forschungslücke anzubieten. Wir entwickeln ein Vermittler-/Matchmaker-Geschäftsmodell für den Platooningmarkt namens XPlatoon. Das Incentivierungsproblem lösen wir durch ein Saving-Reward-System, welches sämtliche Platooning-Teilnehmer fair beteiligt. Mit Hilfe einer Monte-Carlo-Simulation und Sensitivitätsanalyse überprüfen wir das Potenzial unserer Idee und präsentieren einen interaktiven Prototyp.
Keywords	-

Contribution F: The Black Mirror: What Your Mobile Phone Number Reveals about You

Authors	Krüger, N.; Stibe, A.; Teuteberg, F.
Year	2020
Outlet	BIS 2020
Identification	https://doi.org/10.1007/978-3-030-53337-3_2
Online	https://link.springer.com/chapter/10.1007/978-3-030-53337-3_2
Status	Published
Full Title	The Black Mirror: What Your Mobile Phone Number Reveals About You
Short Title	-
Abstract	In the present era of pervasive mobile technologies, interconnecting innovations are increasingly prevalent in our lives. In this evolutionary process, mobile and social media communication systems serve as a backbone for human interactions. When assessing privacy risks related to this, privacy scoring models (PSM) can help quantifying the personal information risks. This paper uses the mobile phone number itself as a basis for privacy scoring. We tested 1,000 random phone numbers for their matching to social media accounts. The results raise concerns how network and communication layers are predominately connected. PSMs will support future organizational sensitivity for data linkability.
Keywords	Privacy, Information privacy, Privacy scoring model, Social media privacy, Mobile phone privacy, Mobile Device Management

Contribution G: Are Hackathons the New MOOCS? On the Outcome of the #WirVsVirus Hackathon From a Learning Outcome Perspective

Authors	Krüger, N.; Teuteberg, F.
Year	2020
Outlet	ECONF 2020
Identification	DOI: 10.1109/econf51404.2020.9385424
Online	https://ieeexplore.ieee.org/document/9385424
Status	Published
Full Title	Are Hackathons the New MOOCS? On the Outcome of the #WirVsVi-rus Hackathon From a Learning Outcome Perspective
Short Title	-
Abstract	The unprecedented situation of the ongoing COVID-19 pandemic holds seed grains for novel phenomena in the field of innovative learning experiences: Virtual hackathon events might represent a new form of remote co-creation, learning and upskilling. The #WirVsVirus hackathon event in Germany has been initiated by the government to compensate the lockdown-related absence of physical innovation experiences. By analyzing the data set of projects initialized during the hackathon event (n = 1,499), plus the qualitative survey feedback from 956 participants, we found that the learning curve as well as the individual learning outcome for the participates is substantial. Our findings presented in this paper lead to the conclusion that hackathons are a prosperous learning environment, even more out-come oriented than classical Massive Open Online Courses.
Keywords	COVID-19, Corona, e-Learning, Hackathons, Co-Creation, Learning Innovations

Contribution H: Exploring User Acceptance Determinants of COVID-19 Tracing Apps to Manage the Pandemic

Authors	Krüger, N.; Behne, A.; Beinke, J.H.; Stibe, A.; Teuteberg, F.
Year	2022
Outlet	IJTHI
Identification	DOI: 10.4018/IJTHI.293197
Online	https://www.igi-global.com/article/exploring-user-acceptance-determinants-of-covid-19-tracing-apps-to-manage-the-pandemic/293197
Status	Published
Full Title	Exploring User Acceptance Determinants of COVID-19 Tracing Apps to Manage the Pandemic
Short Title	-
Abstract	Tracing infectious individuals and clusters is a major tactic for fighting the COVID-19 pandemic. Thus, this paper explores the factors impacting the intentions and actual use of COVID-19 contact tracing apps based on a technology acceptance model with determinants for the intention to use tracing apps. A partial least squares structural equation model has been applied to understand behavioral, technological, social, and pandemic-contextual determinants for the usage of tracing apps based on a large sample ($N = 2{,}398$) from more than 30 countries (mainly from Germany). This paper provides insights for technologists and designers of tracing apps as well as policy makers and practitioners to work toward enhancing user acceptance. Moreover, the results are abstracted to general social participation with apps in order to manage future strategies. The theoretical contribution of this work includes the results of our acceptance model and a classification of COVID-19 tracing and tracking apps.
Keywords	Corona, Digital Contact Tracing, SARS-CoV-2, COVID-19, Technology Acceptance, TAM

Contribution I: Learnings from the Design and Acceptance of the German COVID- 19 Tracing App for IS-driven Crisis Management: A Design Science Research

Authors	Behne, A., Krüger, N., Beinke, J.H., & Teuteberg, F.
Year	2021
Outlet	BMC Medical Informatics and Decision Making
Identification	https://doi.org/10.1186/s12911-021-01579-7
Online	https://bmcmedinformdecismak.biomedcentral.com/articles/10.1186/s12911-021-01579-7
Status	Published
Full Title	Learnings from the Design and Acceptance of the German COVID- 19 Tracing App for IS-driven Crisis Management: A Design Science Research
Short Title	-
Abstract	This article investigates the research problem of digital solutions to overcome the pandemic, more closely examining the limited effectiveness and scope of the governmental COVID-19 tracing apps, using the German COVID-19 tracing app (Corona-Warn-App) as an example. A well-designed and effective instrument in the technological toolbox is of utmost importance to overcome the pandemic.
Keywords	Crisis management, Corona-Warn-App, Tracing apps, Design science, User experience design, Prototype