Digital Innovations in Healthcare: An Analysis of Requirements and Drivers Towards a Stakeholder Network

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Preface

This cumulative dissertation was written during my employment as a research assistant at the Department of Accounting and Information Systems at the University of Osnabrück between November 2019 and May 2023. During this time, I was responsible for the evaluation of the "ReKo – Regionales Pflegekompetenzzentrum" (ReKo) project. The project examined the use of a newly established case management organization in the German counties Grafschaft Bentheim and Landkreis Emsland with the help of appropriate software and improved digital networking for the stakeholders involved in nursing. The project was funded by the "Gemeinsamer Bundesausschuss" with a grant of over 10 million euros with the aim of integrating the concept and digital resources in regular care.

Through this employment, many contacts were established, who then provided valuable data for this dissertation. We also had permission to use interim results of the project for our publications that contribute to this cumulative dissertation.

The publications would not have been possible without the support of my two colleagues Patricia Kajüter Rodrigues and Kevin Kus. I am very happy to have had two such great colleagues and supporters by my side for years. I would also like to thank my doctoral advisor Prof. Dr. Frank Teuteberg for his supervision and advice in my dissertation, as well as for being responsible for the ReKo project. Additionally, I would like to thank Prof. Dr. Oliver Thomas for kindly agreeing to be the second reader of this dissertation.

I also received great support from the entire team at the department and would like to mention Barbara Meierkord, Albin Sonneck, Dr. Thuy Duong Oesterreich, Dr. Julian Schuir, Dr. Eduard Anton, Dr. Alina Behne, Ludger Pöhler, Jonas Hammer, Fabia Hettler, Markus Aptyka, and Aleksandra Flok by name. A special thanks goes to Marita Imhorst, who offered me the greatest possible support even in difficult times.

In addition to my fantastic colleagues, I would like to thank my family and friends who always had an open ear for me when I had worries, and who undoubtedly had to forgive me for some things during certain phases.

A very special thanks goes to my parents Petra and Dr. med. Elmar Arlinghaus, who have enabled me to set the course for this academic path since my birth, aroused my interest in healthcare and instilled virtues in me without which I would not be where I am now.

Osnabrück, June 2023 Tim Arlinghaus

Notes on the Structure of the Document

This cumulative dissertation comprises eight research contributions in the field of digitalization in healthcare. Therefore, this contribution is divided into two parts: Part A includes the motivation, objectives, professional classification and background, methodological foundations of this dissertation, findings of each research contribution, and a discussion thereof. Finally, a conclusion is drawn, and the limitations are presented. Part A can thus be regarded as an independent document, which is supported by its own separate list of abbreviations, figures, tables, and references.

Part B contains a consolidation of the included research contributions, including their respective reference lists. The citation style and the original format of the research contributions have been maintained in the style of the respective journal or conference.

Contents

Part A: Introductory Overview

List of Abbreviations

AI	Artificial intelligence
AMCIS	American Conference on Information Systems
ANT	Actor-network theory
CMSW	Case management software
COVID-19	Coronavirus disease 2019
DSR	Design science research
ePA	electronic patient record
GDPR	General Data Protection Regulation
ID	Identifier
IS	Information systems
JIF	Journal impact factor
PACIS	Pacific Asian Conference on Information Systems
ReKo	Regionales Pflegekompetenzzentrum
TI	Telematics infrastructure
UEC	Utility-effect chains
VHB	Verband der Hochschullehrer der Betriebswirtschaft e.V.
WKWI	Wissenschaftliche Kommission Wirtschaftsinformatik

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1 Introduction

1.1 Background

The healthcare system in Germany symbolizes a chain of challenges with which our society has been confronted. The demand for skilled professionals in this sector has steadily increased in recent years, as the supply has not been able to meet the demand (Merkel, et al., 2019). A significant cause for this inability to meet demand has been the demographic change, that is, the disproportionate aging of the population. The mortality rate in Germany has been higher than the birth rate every year since 1971 (Statistisches Bundesamt, 2023). Although the number of employees in the field of human health and social work in Germany has increased by approximately 19.3%, from 4.857 million in 2013 to 5.793 million in 2022, this growth cannot compensate for the increased workload that has arisen. Apart from the shortage of personnel in the clinical sector (Winter, et al., 2020), a significant undersupply has emerged in elderly and nursing care in particular. While approximately 2.5 million German citizens were classified as in need of care in 2011, this number had nearly doubled by December 2021 and was estimated at 4.96 million. This trend is expected to continue steadily in the coming decades, with the number of people in need of care projected to increase by 1.8 million by 2055. At the end of 2021, approximately 2.7 million, or 55%, of all individuals in need of care were 80 years of age or older. With constant growth in care rates, this number could reach approximately 4.4 million, or 65%, by 2055. This increase will occur primarily between 2035 (3.0 million) and 2055 (Statistisches Bundesamt, 2023).

In 2021, 4.167 million people in need of care in Germany were living at home, of whom approximately 60% were attended to by family caregivers and 25% by outpatient care services (Statistisches Bundesamt, 2023). This represents an enormous additional burden for the caregiving relatives, who may require further support in the form of counseling, digital solutions, and financial assistance. This relates to the next challenge that has been arising concerning the healthcare system: digitalization. Numerous studies have described the potential of digitalization for the healthcare sector, finding that digitalization can lead to cost saving, patient safety, and more efficient treatments. Telemedicine can help close gaps in care and enable remote consultations with medical professionals. Big data has also proven its worth, facilitating intelligent data linkage and analysis in treatments, clinical diagnostics, and research, resulting in leaps in quality of medical care (Bertelsmann Stiftung, 2018). Artificial intelligence (AI) can serve as a decision support system for patients care and has partially outperformed renowned medical professionals in the analysis of imaging procedures (Marizel, 2018).

However, as the fourth-largest industrial nation globally, Germany lags behind the majority of European countries in terms of digitalization (Statista, 2023). The Digital-Health Index developed in 2018 focuses on strategies, technical readiness, and actual data utilization in healthcare in each country, enabling an assessment of each country's placement in the Digital-Health Ranking based on three corresponding sub-indices. In this comparison,

Germany has achieved 30 out of 100 possible points, thereby ranking 16th, just ahead of Poland, with 28.5 points (Bertelsmann Stiftung, 2018).
During the Coronavirus disease 2019 (COVID-19) pandemic, several laws were passed in Germany to accelerate digitalization in the healthcare sector. The Hospital Future Act was passed in 2020. In 2021, to simplify bureaucratic processes for various stakeholders, the electronic patient record (ePA) was introduced for every statutory insured person. The platform used for this was the Telematics Infrastructure (TI), which was introduced in 2020 and was intended to facilitate fast and secure exchange between stakeholders (BMG, 2023). The implementation of e-prescriptions was also seen as a promising intervention, but has not yet provided satisfactory added value for users. The pilot regions even prematurely terminated the field test due to data protection concerns (Kahl & Eckert, 2023).
The mentioned e-prescription case is just one of a few in which data protection mechanisms have been found to significantly hinder digital collaboration in the healthcare context. On the one hand, compliance with the General Data Protection Regulation (GDPR) and the lack of interoperability between the different stakeholders' systems have been considered significant barriers for health professionals. On the other hand, few legitimate independent institutions are capable of accepting, securely managing, and structurally processing sensitive data, particularly from vulnerable target groups (Arlinghaus, et al., 2021; Enaizan, et al., 2020).
In addition to connectivity problems, which can be attributed, for example, to acceptance issues and a lack of IT skills among medical personnel, interventions find little support among users on the patient side (Kajüter Rodrigues, et al., 2022). For example, the ePA has been used by 595,000 people, which is less than 1% of all individuals with statutory health insurance in Germany (Ärzteblatt, 2023).

1.2 Motivation and aim

The healthcare sector is characterized by the necessity for multiple stakeholders to interact, as individuals may need to consult various doctors depending on their medical condition (Melles, et al., 2021). Moreover, throughout their lives, individuals pass through different phases where medical care alone may suffice, but there may be a need for the involvement of outpatient or inpatient care services as well as other providers and therapeutic entities. This comprehensive care of an individual poses a highly complex challenge, where information and diagnoses need to be collected and made accessible to all stakeholders in the German healthcare system to the best possible extent.
It is crucial to highlight the preliminary conditions that must be established in order to create suitable solutions for the multitude of stakeholders. These conditions possess the function of justifying health professionals' trust, acceptance, and willingness to engage in collaborative data exchange and the analysis of health data. An important step that has heightened awareness of AI was the introduction of ChatGPT, which has already been found to have valuable applications in the field of medicine (Hopkins, et al., 2023). Through the rollout of initial versions of ChatGPT, end consumers have recognized that AI can exhibit human-like traits and provide accurate responses within seconds, for which

a human would require hours of research. Given the numerous success stories surrounding AI in healthcare, it is essential to explore the associated opportunities (Nirmala & More, 2020). Additionally, it is important to emphasize how widespread integration of AI in the healthcare sector can be achieved.

RQ1: *Which factors are crucial and which conditions need to be established to advance networking and AI-driven data analysis in the German healthcare system?*

The loss of treatment data in paper form has been found to be common, with different physicians lacking access to each other's findings, leading to redundant examinations that tie up valuable resources (Almacen, et al., 2021; Hassenfeldt, et al., 2021).
This lack of overview is particularly evident among patients and applies especially to older and dependent individuals. Family caregivers have been shown to often be overwhelmed by the dual burden of their own lives and the care of their dependent relatives, highlighting the value of seamless networking and data exchange as valuable assistance (Omiya, et al., 2021). The concept of case management promises to bring together the threads of the stakeholders involved in care and, with appropriate digital support, can play a key role in the coordination of healthcare organizations. It is important to identify the factors and design elements necessary for healthcare professionals and patients to efficiently utilize medical applications for networking and organizing patient data (Löcherbach, 2002). Furthermore, the investigation of use cases is needed to illustrate the characteristics by which end consumers evaluate digital management of their health data as trustworthy and user-oriented, including functionalities that health dashboards for patients must possess to facilitate efficient sourcing.

RQ2: *What functional and non-functional requirements should digital solutions in the healthcare sector meet to increase user acceptance?*

The potential of digitalization remains untapped in the German healthcare sector (Naumann, et al., 2021). While the reforms introduced by the government have laid the foundation for the advancement of digitalization, a consistent implementation of the pursued objectives has often failed due to the various stakeholders involved. This is partly because the value derived from digitalization is not immediately apparent, and cost savings compared to the effort may seem marginal (Bergmo, 2015). Hence, a suitable method for communicating the advantages of digital networking to stakeholders must be made available.

RQ3: *What are the economic benefits of the digital networking of stakeholders in the healthcare sector and how can these be visualized?*

This dissertation considers various research methods and objects of study to address three research questions. The aim is to provide a comprehensive understanding, in an illustrative manner, of the steps to be taken on the roadmap to digitalization in the German healthcare sector and the expected economic outcomes.

2 Research Design

2.1 Selection of the research contributions

This cumulative dissertation encompasses eight research contributions. Table 1 lists the contributions C1–C8. In addition to the respective title, the table includes bibliographic information, the outlet in which the contribution was published, and two official rankings for each publication venue of each contribution. Furthermore, the type of medium, whether conference paper or journal article, is indicated. The rankings are derived from the JOURQUAL 3 ranking by the Association of German Business Professors (VHB e.V., 2021) and the Scientific Commission on Business Informatics (Heinzl, 2008). As one journal was not listed by the WKWI, the Journal Impact Factor (JIF) was included as a quality measure (Resurchify, 2023).

To ensure scientific quality, a multi-stage double-blind peer review process was applied to each of the eight contributions, which were subsequently published either in a well-known journal or presented at a renowned international conference. The contributions were reviewed by at least two expert reviewers for methodological rigor and validity. Five conference papers and three journal articles were selected as contributions for this dissertation.

Six out of the eight contributions were written in English to reach a broader readership. Additionally, the English-language articles include not only country-specific implications, so an exclusive reference to Germany was not mandatory for selection for this dissertation.

The author of this cumulative dissertation published three of the contributions as the first author (C1, C2, and C8), three as a co-author (C3–5), and two as the third and fourth authors, respectively. The authorship was primarily determined based on the individual responsibilities within the research project of the respective research assistants. However, each author was involved in the planning, structuring, methodological approach, and finalization of the contributions. Prof. Dr. Frank Teuteberg significantly contributed to maintaining the quality of each article. He was involved from the outset in the research projects, provided advice on methodological intricacies, and ensured that the work was conducted with scientific responsibility.

Table 1 summarizes the research contributions in this cumulative dissertation.

ID	Bibliographic Information	Ranking	
		WKWI	VHB
C1	**Arlinghaus, T.**; Kus, K.; Kajüter, P.; Teuteberg, F.: Datentreuhandstellen gestalten: Status quo und Perspektiven für Geschäftsmodelle; HMD Praxis der Wirtschaftsinformatik, 2021. *0 *1	Journal	
		B	D
C2	**Arlinghaus, T.**; Kus, K.; Behne, A.; Teuteberg, F. (2022): How to Overcome the Barriers of AI Adoption in Healthcare: A Multi-Stakeholder Analysis; 26th Pacific Asia Conference on Information Systems, PACIS 2022; Taipei, Taiwan. *0 *2	Conference	
		B	C
C3	Kus,K.; **Arlinghaus, T.**; Teuteberg, F. (2022): Analyzing Healthcare AI Adoption in China and Germany under the Lens of the Socio-Technical Theory: A Literature Analysis; 26th Pacific Asia Conference on Information Systems, PACIS 2022; Taipei, Taiwan. *0 *3	Conference	
		B	C
C4	Kajüter, P.; **Arlinghaus, T.**; Kus, K.; Teuteberg, F. (2022): Analysis of Barriers to Digital Linking among Healthcare Stakeholders; Proceedings der 17. Internationalen Tagung Wirtschaftsinformatik (WI 2022); Erlangen-Nürnberg, Germany. *0 *4	Conference	
		A	C
C5	Kus, K.; **Arlinghaus, T.**; Kajüter, P.; Teuteberg, F.: Success factors of Case Management software supporting healthcare patient services - A user-driven perspective; in: Proceedings of the 27th Americas Conference on Information Systems (AMCIS), 2021. *0 *5	Conference	
		B	D
C6	Kus, K.; Kajüter, P.; **Arlinghaus, T.**, Teuteberg, F. (2022): Die elektronische Patientenakte als zentraler Bestandteil der digitalen Transformation im deutschen Gesundheitswesen - Eine Analyse von Akzeptanzfaktoren aus Patientensicht; HMD - Praxis der Wirtschaftsinformatik, 2022. *0 *6	Journal	
		B	D
C7	Kus, K.; Poehler, L.; Kajüter, P.; **Arlinghaus, T.**; Teuteberg, F. (2022): Vaccination Dashboard Development during COVID-19: A Design Science Research Approach; Proceedings der 17. Internationalen Tagung Wirtschaftsinformatik (WI 2022); Erlangen-Nürnberg, Germany. *0 *7	Conference	
		A	C
C8	**Arlinghaus, T.**; Kus, K.; Kajüter Rodrigues, P.; Teuteberg, F. Visualizing Benefits of Case Management Software Using Utility Effect Chains. Sustainability 2023, 15, 4873. *0 *8	Journal	
		JIF: 4.17	C

*0 Prof. Dr Frank Teuteberg critically reflected on the content and methodological orientation in all contributions.
*1 The author of this dissertation conducted and analyzed the interviews and was responsible for the main part of the results and discussion section. Mr. Kevin Kus contributed to the theoretical background section including relevant literature and the discussion section. Mrs. Patricia Kajüter assisted during the visualization and validation process and worked in equal parts on the review.
*2 Mr. Kevin Kus conducted the systematic literature analysis and made a noteworthy contribution to the review process. Mrs. Behne was responsible for the structure and visualization and contributed to the conduction of interviews.
*3 Mr. Kevin Kus provided theoretical insights about the socio-technical theory and national culture research and carried out the analyses by allocating the challenges. The author of this dissertation provided noteworthy justifications for choosing Germany and China, contributed to the introduction section, and gave valuable feedback on the manuscript and the review process.
*4 The author of this dissertation helped analyze the interviews, contributed to the structure of the article, and supported in the discussion section and the review process. Mr. Kus contributed to the theoretical background section.
*5 The author of this dissertation conducted most interviews and contributed to the interview analysis. Mr. Kevin Kus developed the idea of the article, conducted the literature review, and was responsible for the result section. Mrs. Patricia Kajüter contributed to the drafting of the theoretical background.
*6 Mrs. Patricia Kajüter conducted the analysis in the literature section, supported the interview analysis with graphical illustrations and contributed to the discussion section. The author of this dissertation analyzed respective EHR solutions of the insurances and contributed to the review process.
*7 Mr. Ludger Poehler and Mr. Kevin Kus worked in equal parts in this contribution. Mrs. Patricia Kajüter in particular provided valuable support regarding the survey analysis. The author of this dissertation investigated healthcare communication guidelines and contributed to the discussion section and the review process.
*8 The author of this dissertation contributed to the conceptualization, investigation, resources, writing, review and editing, visualization and supervision. Mr. Kevin Kus contributed to the conceptualization, methodology, literature review, validation, reviewing and editing. Mrs. Patricia Kajüter Rodrigues contributed to the conceptualization, validation, review and editing, visualization.

Legend
VHB = Verband der Hochschullehrer für Betriebswirtschaftslehre (English Translation: German Academic Association for Business Research)
Journal Quality Index 3 (VHB 2015).
WKWI: Wissenschaftliche Kommission Wirtschaftsinformatik — Orientierungsliste 2008 (English translation: Scientific
Commission Information Systems — Guidance List 2008) (Heinzl, 2008).
JIF = Journal Impact Factor according to Resurchify (Resurchify, 2023)

Table 1: Overview of the research contributions

2.2 Spectrum of Methods

Fundamentally, quantitative research is considered more object-oriented, aiming to identify explanations and causal relationships, while qualitative approaches tend to be interpretative and emphasize subjective understanding (Lamnek, 2006).
This present dissertation addresses areas of research that still contain significant gaps and thus lack measurable data. This can be illustrated by selected research areas: Although AI has not yet been implemented in healthcare, relevant software exists, making the question of "Why is this the status quo?" of great importance (C2; C3). Similarly, there are only a handful of data trustees that can serve as service providers for medical institutions or research projects, despite high demand (C1). Again, the question of "why" is central.
The situation differs somewhat regarding the contributions to case management software (CMSW) and the ePA (C5; C6). CMSW was gradually developed within the framework of a case study, resulting in a measurable artifact. However, this digital innovation, as well as the field of case management itself, is still in its infancy, and the number of users has been very limited. It is crucial to determine the requirements of these new users for software. As mentioned earlier, the ePA has encountered limited acceptance and has only been available to insured individuals for a few months. Consequently, little is known about the reasons for the current rejection of this innovation. Therefore, the purpose of this dissertation is to provide a deeper understanding of intentions, preferences, needs, and acceptance factors for which exploratory research approaches have proven effective (Makri & Neely, 2021).
Exploratory research methods are of a qualitative nature and encompass surveys, focus groups, interviews, systematic reviews, and systematic literature searches.
Within the scientific community, there are tendencies regarding which methodology prevails depending on the field. A cross-sectional study from 2021 demonstrated that qualitative research, with a focus on interviews, has been predominantly applied in the medical field. The "nursing" field ranked first, while "health professions" and "medicine" were also among the top eight out of 27 research fields (Thelwall & Nevill, 2021).
Each of the contributions included a systematic literature review with specific search strings. Conducting a systematic literature review allowed for a comprehensive synthesis of the current state of knowledge on the topic, thus enabling the identification of research gaps, the formulation of research questions, the planning of research designs, as well as the extraction, synthesis, and evidence-based derivation of conclusions for each respective paper (Templier & Paré, 2015). The utilization of qualitative research methods in the present research field is thus congruent with the customary approach to research.
Considering the innovativeness of the research area under investigation, interviews were predominantly chosen as the methodology in the majority of cases, with the aim of gaining comprehensive insights into complex matters, obtaining qualitative expert knowledge, and acquiring specific information related to the research questions (Döringer, 2021; Gläser, et al., 2010).

In conjunction with conducting interviews, focus groups, and systematic literature reviews, a qualitative content analysis was performed in each article. Qualitative content analysis is a method of data analysis that involves systematically identifying, categorizing, and interpreting content from texts, interviews, or other qualitative data to discover and understand patterns, themes, and meanings (Mayring, 2010).
Furthermore, in contribution C7, the Design Science Research (DSR) approach was applied, utilizing prototyping as another qualitative method (Peffers, et al., 2007).
Structuring frameworks such as the digital canvas in contribution C1 (Schlimbach & Asghari, 2020), the socio-technical theory framework in C3 (Bostrom & Heinen, 1977), and the belief-action-outcome framework in C2 (Melville, 2010) were also employed in this dissertation. Frameworks are useful in scientific work as they provide a structured basis for analyzing research questions, organizing concepts, and developing research designs, thereby contributing to the coherence and clarity of the work (Ravitch & Riggan, 2012).
Additionally, in contribution C7, a mixed-methods approach was employed.
This has been applied when it is necessary to comprehensively investigate complex research questions or phenomena and gain a deeper understanding by combining quantitative and qualitative methods. A mixed-methods approach allows for more comprehensive data collection, result triangulation, and a more thorough interpretation of research findings (Wasti, et al., 2022).
In conjunction with the DSR approach, this was particularly suitable since qualitative investigations in advance provided fundamental insights into the necessary factors of a dashboard.
It is important to note that this cumulative dissertation embraced diverse research methods. Due to the selected subject of investigation, qualitative methods were predominant in shaping its character. For a detailed listing of the applied methods in each respective contribution, please refer to Table 2.

Research Method	**Contribution**								**References**
Qualitative Research	C1	C2	C3	C4	C5	C6	C7	C8	
Literature Review	x	x	x	x	x	x	x	x	vom Brocke et al. (2009)
Expert Interviews	x	x		x	x	x	x		Gläser and Laudel (2010)
Qualitative Content Analysis	x	x	x	x	x	x	x	x	Mayring (2014); Mayring (2010); Bandara et al. (2015)
Case Study				x	x			x	Cronin (2014)
Focus Groups								x	Breen (2006)
Prototyping							x		Peffers et al. (2007); Venable et al. (2016)
Quantitative Research									
Survey							x		Hunt and Scheetz (2019)
Frequency Analysis		x		x					Mayring (2014)

Table 2: Research methods employed in this dissertation

2.3 Framework of the research contributions

Within the framework of this cumulative dissertation, only contributions that concentrated on the digital interaction among various stakeholders in healthcare were included. The research questions aimed to explore the prerequisites needed for seamless interaction among the actors. Additionally, selected digital solutions were examined to describe the required characteristics that would make these solutions acceptable, ultimately applicable, and desirable in practice. Ultimately, the work was synergistically concluded by considering the potential arising from improved networking and its implications for individual stakeholders.

The actor-network theory (ANT) by Bruno Latour (1996) is a theoretical approach that suggests social phenomena should be viewed as networks of actors interacting with each other. ANT considers both human actors and non-human entities as equal participants that stand in relationships and collectively construct social realities. ANT emphasizes the role of matter, technology, and non-human elements in shaping social processes and highlights the importance of analyzing networks to understand the dynamics of social phenomena. ANT claims that every actor has equal relevance in a network, regardless of whether it is software, a digital device, a legal regulation, or a human being (Latour, 1996). This interplay of numerous entities is intended to apply to the interconnection of the contributions in this cumulative dissertation as well, as they are all dependent on each other or, in some cases, serve as prerequisites for one another.

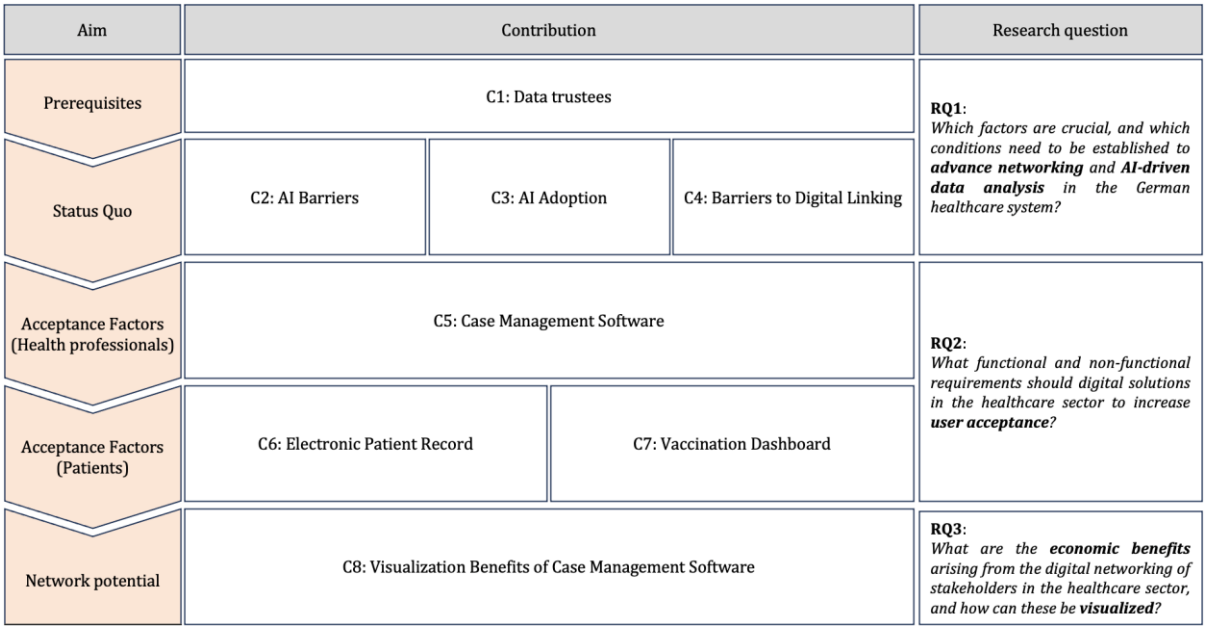

Figure 1: Framework of the contributions according to Freundlieb (2012)

As a basis, the contributions C1–4 lay the groundwork for understanding the willingness of healthcare professionals to accept or reject digital solutions. Additionally, these contributions discussed the prerequisites that are considered essential for establishing a functioning digital network in healthcare.

Another level to consider was the implementation of digital solutions. Contributions C5–7 highlighted, through three examples, how these solutions need to be designed for patients and healthcare professionals in order to be applicable in the future and what conditions need to be established for their practical implementation.
Finally, contribution C8 contributed to the economic visualization of network activities by providing a quantitative summary of the potentials that can arise when the previously postulated suggestions and implications are effectively implemented.
Figure 1 illustrates the framework of the cumulative dissertation presented here.

3 Synthesis of the Research Contributions

3.1 Prerequisites for digital networks and AI in healthcare

3.1.1 Secure data storage

In the field of medicine, a variety of different types of data are collected and managed, including personal master data, demographic data, and sensitive treatment data, which are specifically protected under Article 9 of the GDPR (Showell, et al., 2017). While the GDPR, introduced in 2018, aims to protect the privacy rights of citizens, it presents significant challenges for healthcare actors when it comes to digital networking through data exchange and system sharing, as well as the intelligent analysis of health data, which is widespread due to legal barriers (Beltempo, et al., 2023).

At this point, data trustee organizations, also known as trusted intermediaries, can be a viable solution to ensure compliance with legal requirements while facilitating efficient data storage and processing (Blankertz, et al., 2020). There is a significant need for data trustee organizations in research and healthcare institutions in Germany. Medical research projects have faced serious difficulties in finding providers willing to accept and process sensitive data from vulnerable target groups. Some potential providers have even been deterred from offering their services due to the risk of data loss or hacking (Pommerening, et al., 2015).

Due to the increasing demand for data trustee organizations, an overview of the business model of such organizations was created using the digital canvas, an adaptation of the original business model canvas (Schlimbach & Asghari, 2020). This overview revealed a wide range of business fields where data trustee organizations are needed, presenting numerous opportunities. In addition to the extensive application in research, science, and medicine, there have been use cases in the insurance, marketing, and even construction and automotive industries.

The characteristics of data trustee organizations embedded in the digital canvas can be found in Figure 2. Data trustee organizations offer many advantages that could be utilized in the healthcare sector. Firstly, they can process large data streams, ensuring the secure processing of training data for AI. The data can also be encrypted by the provider using blockchain technology, making it tamper-proof. Moreover, data flows can be regulated through tokens, thereby facilitating secure and streamlined access to patient data, such as image data, between health institutions (C1).

According to interviews, one of the greatest values that data trustee organizations bring is the implied trust that is often lacking between healthcare actors and patients concerning technology. With the help of data trustee organizations, a secure data foundation can be established in the healthcare sector, enabling stakeholders to access, share, and analyze data based on highly secure technology while overcoming potential user acceptance issues (C1).

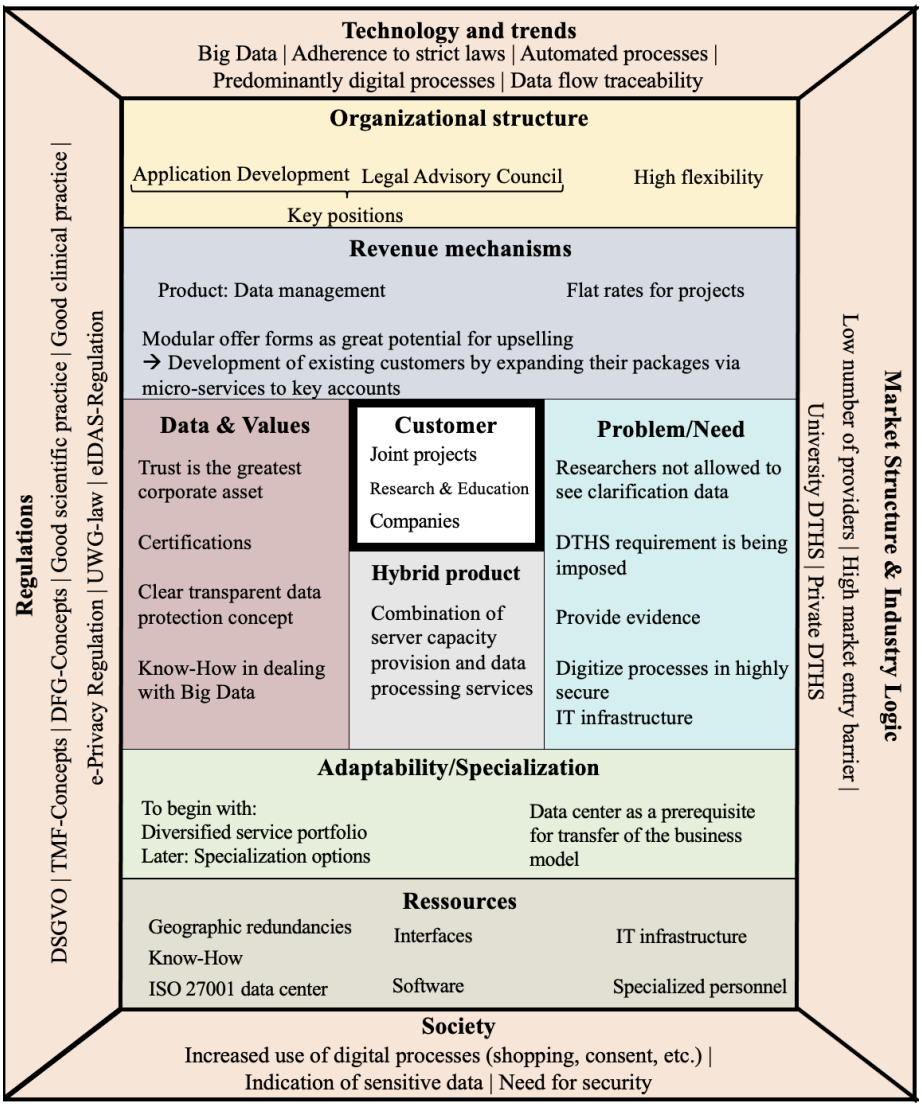

Figure 2: Business model for data trustees following the digital canvas (Arlinghaus, et al., 2021)

3.1.2 AI adoption in German healthcare

AI is undeniably one of the greatest innovations of the 21st century. However, it should not be used only for the sake of using it, but rather because of its helpfulness. In the field of medicine, there have already been numerous use cases where AI delivered more accurate analyses than actual medical specialists (Nirmala & More, 2020). AI can be used, among other things, in imaging procedures to recognize patterns that have been developed with a vast amount of training data (Shi, et al., 2020). It can act as a decision-support system, providing recommendations on the most promising treatment approach. It has even been applied in surgery, to assist humans in performing delicate movements during operations that may be impractical or carry a high risk due to human characteristics such as tremors, nervousness, lack of concentration, or fatigue (Liu, et al., 2022). Despite the advancements in AI, healthcare professionals continue to harbor numerous concerns regarding the practical implementation of this technology (Cartolovni, et al., 2022).

Based on 16 expert interviews and a systematic literature review, insights into the barriers that need to be overcome before AI can be effectively utilized in German healthcare were identified and are depicted in Table 3.
The most serious barriers that emerged from the interviews conducted are:

1. **Lack of standardized regulations and guidelines**: The lack of clear and standardized regulations and guidelines for the implementation of AI creates uncertainty among healthcare organizations. Legal and ethical concerns related to the implementation of AI, including issues of liability, privacy, and data security, act as significant barriers.
2. **Interoperability and integration challenges:** The lack of interoperability between different health information systems hinders the seamless integration of AI technologies. Limited connectivity and restricted data sharing affect the potential of AI in healthcare facilities.
3. **Data quality and availability:** High-quality, reliable, and readily available data are essential for successful AI implementation. However, healthcare organizations often face challenges in ensuring data quality, consistency, and accessibility. Inadequate data infrastructure and variability in data formats have hindered the effectiveness of AI.
4. **Technical limitations of AI algorithms:** AI algorithms must have a high level of accuracy, reliability, and interpretability to gain the trust and acceptance required for implementation in healthcare. The technical limitations of AI, such as algorithm bias, lack of explainability, and potential errors, contribute to the reluctance to adopt AI technologies.
5. **Acceptance and trust issues among health professionals:** Health professionals' acceptance of and trust in AI systems play a critical role in the use of such technologies. Resistance to change, concerns about job displacement, skepticism about the capabilities of AI, and a lack of familiarity with AI technologies have been found to hinder the implementation process.

	#	Keyword(s)	Short description	References
Social Barriers	SB1	Appraisal	Lack of human characteristics; degraded practitioner-patient relationship	EAI5; (Cresswell et al. 2018; Khaled et al. 2019; Petersen et al. 2019)
	SB2	Acceptance	Lack of trust (regarding data security; interpretability; negative publicity)	EAI6,EC2,EP1,EP2,EP3,ES1,ES2,ES3; (Shaw et al. 2019; Cresswell et al. 2018; Ben-Israel et al. 2020; Lee and Yoon 2021)
	SB3	Understanding	Lack of awareness; exaggerated expectations; misbelief	EC3
	SB4	Fear	Fear of unknown effects due to AI (du to missing knowledge about AI); Existential threat (like job loss)	EP2,ES2; (Shaw et al. 2019; Ivanov and Webster 2017; Geetter and Van Demark 2017; Denecke and Gabarron 2021)
	SB5	Human rights	Discrimination: (1) of people who avoid technology use; (2) because of cultural orientation of software engineer	EP2; (Pesapane et al. 2018; Nuffield Council on Bioethics 2018)
Economic Barriers	EcB1	Investment	Conflict of institutional short-term profit orientation and AI-implementation cost; high fees for use of AI	EAI1,EC2,EC3,EP2,ES1; (Dwivedi et al., 2019; Sun and Medaglia 2019)
	EcB2	Cost-benefit	Vagueness in measuring general profitability	EAI3, EP2
	EcB3	Company characteristics	Unfair economic conditions between institutions; bigger profit-orientation in bigger companies	EP2; (Shaw et al. 2019; Meinhardt 2019)
Technological Barriers	TB1	IT Infrastructure	Lack of a consistently acceptable IT infrastructure as a basis for AI integration	EAI1,EAI2,EAI3,EAI6,EAI7,ES1; (Sogani et al. 2020; Iliashenko et al. 2019; TMF 2017)
	TB2	Data quality	Lack of stable data quality (risk of bias; necessity of real-time data adding; tracking data sources; test-reality outcome discrepancy; wrong interpretation from correlation to causality)	EC3,EP1,EP2; (Shaw et al. 2019; Kelly et al. 2019; Liyanage et al. 2019; Ben-Israel et al. 2020; Ellahham et al. 2019; Ethics Council Germany 2017; Petersen et al. 2019)
	TB3	Complexity	Lack of robust explainability of AI mechanisms (black box)	(Kelly et al. 2019; Ben-Israel et al. 2020; Markus et al. 2020; Cao et al. 2021)
	TB4	Data security	Potential data security breaches; inadmissible data security	(Shaw et al. 2019; Ben-Israel et al. 2020; Ellahham et al. 2019)
	TB5	Data quantity	Dependency on high data amounts, insufficient data quantity	(Dwivedi et al. 2019; Ellahham et al. 2019; Komorowski 2019; Petersen et al. 2019)
	TB6	Disease analysis	Validation of clinical relevance needed	EP3; (Kelly et al. 2019)
	TB7	Mismatch	Gap between technical research and practical requirements	EAI3; (Khanna et al. 2013)
Organizational Barriers	OB1	Admission	Intransparent and strict admission process	EAI3, EAI7
	OB2	Job roles	Team structure not suitable for AI realization, management of new practitioner's role; avoidance of job losses due to AI	(Shaw et al. 2019; Khaled et al. 2019; Ivanov and Webster 2017; Komorowski 2019)
	OB3	Decision management	Reduced decision-making power for physicians; decision-making power merely in management	EC2, EP1
	OB4	Readiness for change	Unwillingness to give up old steps of procedure	EP2; (Pesapane et al. 2018; Ivanov and Webster 2017; Wamba and Queiroz 2021)
	OB5	Shortage of doctors	Increased workload through demographic change, thus less time for new technologies	EP2; (Mindfields 2018)
	OB6	Communication	Lack of cooperation between organizations	EAI2
	OB7	Organizational culture	Lack of ability and willingness of digitalized trans-formation, less ability for data sharing	EAI2; (Wiljer and Hakim 2019; Recht et al. 2020; Geetter and Van Demark 2017)
Political Barriers	PB1	Global borders	Intransparency through non-uniform governmental handlings; retention of information by some nations	EP2; (Diebolt et al. 2019; Recht et al. 2020)
	PB2	Comparison	No orientation to other countries and neglection of country-specific characteristics	EAI1
	PB3	Regulations: Data protection	Complexity of privacy laws; data protection law not adjusted to new technical possibilities; regulatory reduce innovativeness	EAI2,EAI3,EAI5,EAI6,EP1,EP3; (Pesapane et al. 2018; Ethics Council Germany 2017; Jaremko et al. 2019)
	PB4	Regulations: Admission	Too cautious admission approach; intransparency about set quality standards	EAI7; (Pesapane et al. 2018; Cresswel et al. 2018)
Ethical Barriers	EB1	Failures	Responsibility and dealing with mistakes; liability in case of bad outcomes of AI	EAI3,EP1; (Sogani et al. 2020; Pesapane et al. 2018; Cresswell et al. 2018; TMF 2020; Meinhardt 2019; Petersen et al. 2019)
	EB2	Future direction	Uncertainty about effects of too much information	EC2,EP1
	EB3	Misuse	Misuse of AI applications and data; unclear ownership of data; potential discrimination by employers or insurances	EAI6,EP2; (Pesapane et al. 2018; Liyanage et al. 2019; Thesmar et al. 2019;)
	EB4	Privacy loss	Potential reidentification of data; potential loss of privacy	(Ethics Council Germany 2017)
Education Barriers	EdB1	Training	Need for adequate education programs due to staff's inability of system use (especially long-time employees)	EAI1,EAI7,EC2,ES3; (Cresswell et al. 2018; Khaled et al. 2019; Wiljer and Hakim 2019;
	EdB2	Understanding	Vague understanding of AI	EAI3,EAI7
	EdB3	Cooperation	Asymmetries between research and practice	EAI3,EP1,EP3
	EdB4	Curriculum	Outdated education content for medical students	EAI7,ES1,ES2,ES3

Table 3: Overview of barriers for AI adoption in healthcare (Arlinghaus, et al., 2022)

Finally, the question arises as to what measures can be taken to accelerate the adoption of AI in healthcare. The triangulation of interview data and literature review yielded a selection of the five most relevant actions:

1. **Establish clear regulatory frameworks:** Clear and standardized regulations and guidelines need to be developed for the implementation of AI in healthcare. These frameworks should address legal and ethical concerns while ensuring patient privacy and data security.

2. **Improve interoperability and integration:** Efforts should be made to improve interoperability among different health information systems. Seamless connectivity and the ability to exchange data are crucial for harnessing the full potential of AI in healthcare.
3. **Enhance data quality and availability:** Investments should be made in improving data infrastructure, including standardizing electronic health records, to ensure high-quality, reliable, and accessible data. Data consistency, accuracy, and availability are critical for effective AI implementation.
4. **Address technical limitations:** Technical challenges associated with AI algorithms, such as bias, lack of explainability, and potential errors, should be actively addressed. Improving the technical capabilities of AI algorithms and ensuring their accuracy and reliability are crucial for building trust among healthcare professionals.
5. **Promote education and training:** Comprehensive education and training programs should be implemented to enhance AI literacy among healthcare professionals. These initiatives can address resistance to change, skepticism, and fears of job loss, thereby promoting a positive attitude towards AI adoption.

Some of these findings align with research contribution C3, which highlighted the differences in AI adoption in healthcare between Germany and China. In general, it was postulated that the introduction of a new technology can only succeed at the macro level by creating suitable regulatory frameworks at the state level. Significant regulations to mention include the GDPR, which is similarly enforced in China and has some stricter specifications. However, unlike German law, China allows the use of patient data without their consent if complete anonymization can be ensured. Consequently, China manages to comply with data protection regulations but is confronted with unanswered ethical questions. China's strategy has been to prioritize the development of the necessary technology, addressing ethical issues as secondary concerns (Zhang & Gao, 2019).
An evident discrepancy can be observed in the comparison between the two countries, particularly in terms of investment enthusiasm. Between 2013 and 2018, 60% of the globally invested capital in AI was in China (China Institute for Science and Technology Policy, 2018). Beijing alone invested 34 billion euros between 2015 and 2018 (Deng, 2018), while Germany planned to invest 3 billion euros within the next seven years in 2018. In an adapted version of the strategy, the investment volume for Germany was increased to 5 billion euros in 2020 (The Federal Government, 2020).

3.1.3 Barriers to digital linking in healthcare

In this subsection, the previously mentioned ANT was used to illustrate the barriers that can be identified in the German healthcare system and how they relate to the previous topics concerning AI.
Based on the literature analysis and expert interviews conducted, 35 barriers to digital linking were identified. Following the categorization proposed by Khalifa (2013), Teckert (2020), and Stratil et al. (2017), these barriers can be grouped into six categories, as

shown in Table 4. Table 4 also provides three additional dimensions, as suggested by Vogelsang et al. (2019), to enhance the communication of barriers. On the one hand, the columns indicate whether the respective barrier can be located at the micro, meso, or macro level, as well as which influence the barrier has on IT adoption (social, socio-technical, or technical). On the other hand, they highlight the stakeholders' perceptions regarding the resolution of these barriers.

		Level			IT-Influence			Perception		
Category	Barriers	micro	meso	macro	social	socio-technical	technical	standing by	fear of	lack of
Individual	Individual change resistance (I1)	x			x			x		
	Loss of control (I2)	x			x				x	
	Lack of competence (I3)	x				x				x
	Uncertainties (I4)	x			x			x		
	Low perceived need (I5)	x			x			x		
	Mistrust (I6)	x			x				x	
	Lack of commitment (I7)	x			x					x
	Lack of acceptance (I8)	x				x				x
	Security concerns (I9)	x				x			x	
Legal	Missing guidelines (L1)			x		x				x
	Regulation (L2)			x	x					x
	Bureaucracy (L3)			x	x			x		
	Data protection (L4)			x		x			x	
Financial	Costs of technologies (F1)			x			x			x
	Lacking support (F2)			x	x					x
	Limited resources (F3)		x		x					x
	Opportunity costs (F4)		x		x			x		
	Reimbursements (F5)		x		x					x
	ROI (F6)		x		x			x		
Institutional	Lack of processes (IS1)		x	x	x					x
	Institutional change resistance (IS2)		x		x			x		
	Complex processes (IS3)		x		x			x		
	Time-efficiency (IS4)		x	x	x			x		
Technological	Network coverage (T1)			x			x			x
	Deficient equipment (T2)		x				x			x
	Conflicting standards (T3)		x	x			x			x
	Technological constraints (T4)		x	x			x			x
	Lack of platforms (T5)		x	x			x			x
	Discrepancy of implementation (T6)		x				x	x		
Workforce-related	Limited IT staff (W1)		x			x				x
	Lack of time (W2)		x		x					x
	Heavy workload (W3)		x		x			x		
	Competing priorities (W4)		x		x			x		
	Lack of HR (W5)		x		x					x
	Additional work (W6)		x		x				x	

Table 4: Barriers to digital linking in relation to the dimensions “level”, “IT-influence” and “perception” (Kajüter, et al., 2022)[1]

The barriers of security concerns, complex processes, time efficiency, discrepancy in implementation, lack of HR, and additional work were not mentioned in the identified literature within this research context and emerged solely from the conducted interviews.

[1] The original references can be retrieved from Part B; Contribution 4 of this cumulative dissertation

In addition, a frequency analysis was performed to assign weights to the mentioned barriers and embed them into the ANT. These barriers symbolize the significant challenges that need to be overcome to further advance digitalization.

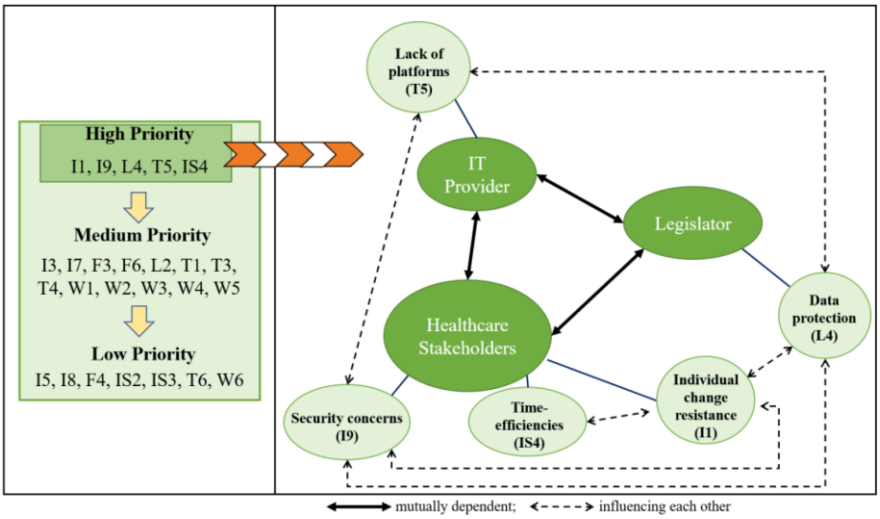

Figure 3: ANT Intertwining of the highest priority barriers (Kajüter, et al., 2022)

Figure 3 illustrates the interplay of actors in the healthcare sector, implying an absolute interdependence among them. The most frequently mentioned barriers are interconnected, indicating that these hurdles need to be addressed from multiple perspectives.
These same five barriers can be found in the previous chapters, where the common denominator was also the lack of platforms, various security concerns, and data protection issues. Individual change resistance can be found within contribution C2, specifically within the organizational barriers (OB2).

3.2 Acceptance of digital healthcare solutions

3.2.1 Software acceptance by healthcare professionals

The second important pillar identified in this cumulative dissertation was the use of software in healthcare. As mentioned earlier, numerous barriers that hinder the adoption of technical solutions have been found at the technical, organizational, and legal levels (C1-3). On an individual level, several barriers related to digital connectivity were identified in contribution C4. The next step was to evaluate the factors that can prevent such acceptance issues from arising in the first place.
A crucial prerequisite for investigating software at the user level was the case study on the ReKo project, which aimed to improve the organization of care for the elderly and their caregiving relatives (Fitte & Teuteberg, 2019). Case managers were employed to specifically address the needs of clients and provide support throughout the six phases (cf., Figure 4). Through a literature analysis, significant insights were gained regarding the acceptance factors that play a role in the development of healthcare software for patient service and the factors that are fundamentally crucial for successful adoption.

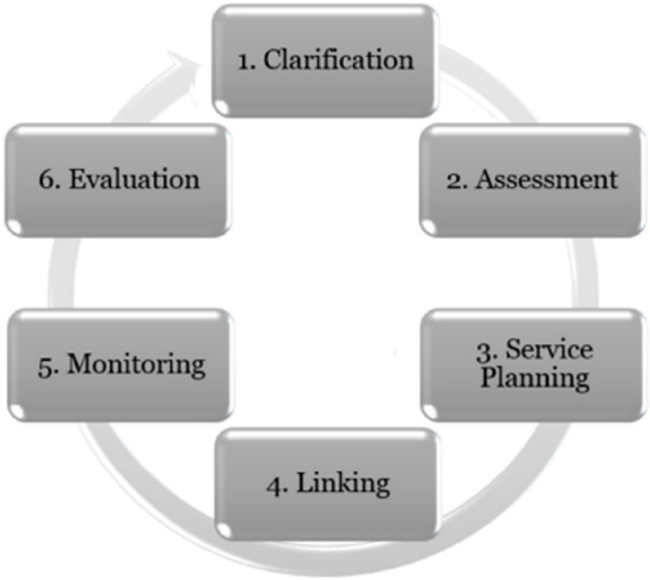

Figure 4: Case management phases according to Löcherbach (2002)

These individual factors could be grouped into “functional factors,” “non-functional factors,” “individual factors,” and “environmental factors” (cf., Table 5).

Based on the conducted interviews, a comparison was made to determine which factors are universally applicable as well as the specific influences relevant to the introduction of CMSW. The documentation of extensive client information plays a central role in making CMSW useful. However, this alone would not differentiate CMSW from other patient service software, therefore, particular attention was paid to identifying differences that interviewees recognized compared to software used in their previous care professions.

One significant difference from other software was the incorporation of the six previously mentioned case management phases, which form the core of CMSW utilization and provide a guiding framework for the software. Due to the travel activities of case managers, offline functionality is essential as internet connectivity is often unavailable, particularly in rural areas where complex cases may arise.

In terms of the software development approach, this case study set a precedent. The software was developed gradually in collaboration with the users, undergoing numerous feedback loops for refinement. As a result, developers gained a deeper understanding of the work performed by case managers and, reciprocally, case managers developed an understanding of the feasible functionalities. Consequently, the software gained significant user acceptance as it presented a customized solution tailored to the needs of case managers.

The influence of training on the respondents plays a substantial role, as mentioned by every case manager interviewed. They emphasized the diversity of IT competencies among users in the nursing field.

Case managers advocated for individualized training sessions for less proficient user groups to ensure equal access to the software. Furthermore, it was suggested that software modularity is desirable, as modularity would allow for customization and thereby

enable the software to appear different to various users by hiding complex functions that might confuse unskilled users, while still providing significant benefits.

System adoption factors		Description	Literature sources
Software related factors	**Functional factors**	**Overall usefulness of the system**	Ebad 2020; Handayani et al. 2018; Lee et al. 2009
	Communication	(Internal) communication with colleagues	Cano et al. 2015; Chirambo et al. 2018
	Decision making	Decision taken by software	Koehler et al. 2015; Koumaditis et al. 2013; Ward et al. 2008
	Documentation	Documentation of new client-related information	Chirambo et al. 2018; Ward et al. 2008
	Guidance	Guidance through the system; decision facilitation	Chirambo et al. 2018; Koehler et al. 2015
	Healthcare provider integration	Integration of data and messages of other healthcare stakeholders or systems into the software	Alyousef et al. 2017; Brown et al. 2020; Cano et al. 2015; Carayon et al. 2019; Ebad 2020; Gagnon et al. 2012
	Integration in daily procedures	Overall software fits with healthcare workers' daily working routines	Gagnon et al. 2012; Lee et al. 2009; Meri et al. 2017
	Overarching insights	Possibility for user to look into colleagues' cases entries	Carayon et al. 2019
	Performance evaluation	System ability to evaluate CMs' working performance	Koehler et al. 2015
	Task allocation	Task distribution possibility among colleagues	Koehler et al. 2015; Koumaditis et al. 2013
	Non-Functional factors		
	Centrality of CMSW	Avoidance of too many internal information systems	Alyousef et al. 2017
	Collaborative software optimization	Possibility to give feedback about software experience; Long-term oriented plan of system integration	de Veer et al. 2011; Gagnon et al. 2012; Handayani et al. 2018; Koehler et al. 2015; Koumaditis et al. 2013
	Data security	Password-requirement for system-login; Compliance with data laws; Authorization for case insights	Cano et al. 2015; Handayani et al. 2018; Koehler et al. 2015; Koumaditis et al. 2013; Lee et al. 2009; Meri et al. 2017; Ward et al. 2008
	Design	Friendly user-interface, color usage	Ebad 2020; Gagnon et al. 2012; Lee et al. 2009; Ward et al. 2008
	Flexibility	Possibility to use the software with multiple devices; Possibility to personalize software attributes	Cano et al. 2015; Chirambo et al. 2018; Carayon et al. 2019; Koehler et al. 2015
	Information adequacy	Information quality and completeness (including EHR); Implies data imported to or generated in the system	Brown et al. 2020; Carayon et al. 2019; Davidson et al. 2020; Handayani et al. 2018; Koehler et al. 2015
	Operability	Ease of use; System complexity	Carayon et al. 2019; Davidson et al. 2020; de Veer et al. 2011; Handayani et al. 2018; Meri et al. 2017
	System reliability	Low risk of downtime; Low risk of other system errors	Carayon et al. 2019; Chirambo et al. 2018; de Veer et al. 2011; Gagnon et al. 2012; Koehler et al. 2015
	Technical support	Provision of technical support in case users have difficulties with handling the software	Chirambo et al. 2018; Davidson et al. 2020; de Veer et al. 2020
	Time efficiencies	Avoidance of data entry in multiple systems and paper documentation; Time efficiencies through systems usage; Automation	Alrahbi et al. 2019; Brown et al. 2020; Carayon et al. 2019; Chirambo et al. 2018; Gagnon et al. 2012; Ward et al. 2008
	Training	Provision of training sessions to educate how to use the system adequately	Alrahbi et al. 2019; de Veer et al. 2011; Ebad 2020; Gagnon et al. 2012; Handayani et al. 2018; Lee et al. 2009; Meri et al. 2017
Individual and environmental factors	**Individual factors**		
	Experience	Users' previous IT/software experience	Chirambo et al. 2018; Gagnon et al. 2012; Koumaditis et al. 2013; Ward et al. 2008
	Motivation	Users' motivation to integrate the software into routines	Gagnon et al. 2012; Handayani et al. 2018
	Skills	Skills and qualification regarding IT usage	Brown et al. 2020; de Veer et al. 2011
	Environmental factors		
	IT infrastructure	Existence of adequate IT infrastructure (Internet connection, hardware provision, etc.)	Alrahbi et al. 2019; de Veer et al. 2011; Handayani et al. 2018; Koumaditis et al. 2013; Lee et al. 2009; Meri et al. 2017
	Organizational support	Organizational attitude towards system usage	Alrahbi et al. 2019; Gagnon et al. 2012; Handayani et al. 2018; Koumaditis et al. 2013
	Client relationship	Influence of client-employee relationship on IT usage	Gagnon et al. 2012; Koehler et al. 2015; Lee et al. 2009
	Time constraints	Limited time of employees to get familiar with system	de Veer et al. 2011; Gagnon et al. 2012

Table 5: Success factors for healthcare software adoption (Kus, et al., 2021)

Table 6 reflects the statements on acceptance factors exclusively derived from the interviews. The cross-matrix illustrates the frequency of mentions of various acceptance factors. The bolded functionalities were exclusively mentioned in the interviews and thus highlight difference from the previous literature analysis.

Consistent with the previous contributions C1–4, it is important to highlight that the possibility of digital networking was mentioned as a prerequisite for software acceptance. Interestingly, in this context, data security was mentioned more frequently in the literature than in the interviews. However, upon inquiry, it was noted that this is less of a concern on a closed platform. With future integration into the telematics infrastructure,

transmission paths to connected stakeholders should also be secure. As evident in Table 6 (*IS4*), time efficiencies were attributed great importance. Consequently, the present digital solution in the case study provided initial approaches to rendering the barriers outlined in Chapter 3.1 more manageable.

System adoption factors		CM1	CM2	CM3	CM4	CM5	CM6
Software related factors	**Functional factors**						
	CM phases integration		x	x	x	x	x
	Communication	x	x	x	x	x	x
	Documentation	x	x	x	x	x	x
	Geographical navigation					x	
	Goal management		x	x			
	Guidance		x	x		x	x
	Healthcare provider integration	x	x	x	x	x	x
	Memory and calendar	x	x		x		x
	Overarching insights	x				x	
	Planning option						x
	Task allocation	x	x	x	x		
	Non-functional factors						
	Collaborative software optimization	x	x	x	x	x	x
	Data security						x
	Design	x				x	x
	Flexibility	x	x	x	x	x	x
	Operability	x	x	x	x	x	x
	System reliability			x	x		
	Time efficiencies	x	x	x	x	x	x
	Training	x	x	x	x	x	x
Individual and environmental factors	**Individual factors**						
	Experience			x	x		x
	Knowledge	x		x	x		x
	Motivation		x	x	x		x
	Self-confidence				x		x
	Environmental factors						
	IT infrastructure			x			
	Client relationship		x	x	x		x

Table 6: Success factors for CMSW according to case managers (Kus, et al., 2021)

3.2.2 Software acceptance by patients

After this dissertation provided insights into necessary data platforms and barriers to individual software solutions such as AI, CMSW was analyzed, in terms of its acceptance factors, as an exemplary networking platform for a case management organization with other stakeholders in the healthcare sector, such as hospitals, physicians, and therapists. Now, another group of stakeholders, namely patients and insured individuals, was included in this collection. For this purpose, two practical examples that emerged in the past two years and involve end-users in the digitalization of healthcare were considered.
Contribution C6 focused on the acceptance factors of the ePA from the perspective of insured individuals in Germany. In line with the exploratory research approach, 16 interviews were conducted, which identified six possible acceptance factors for the ePA. The secondary acceptance factors “information status”, “habits and normative influences”, and “data protection” were shown to be prerequisites that determine whether there is

any initial use of the presented solution. The primary influencing factors “user-friendliness”, “media literacy”, and “functionalities” were moderating factors that were shown to influence the user positively or negatively regarding the digital solution (cf., Figure 5).

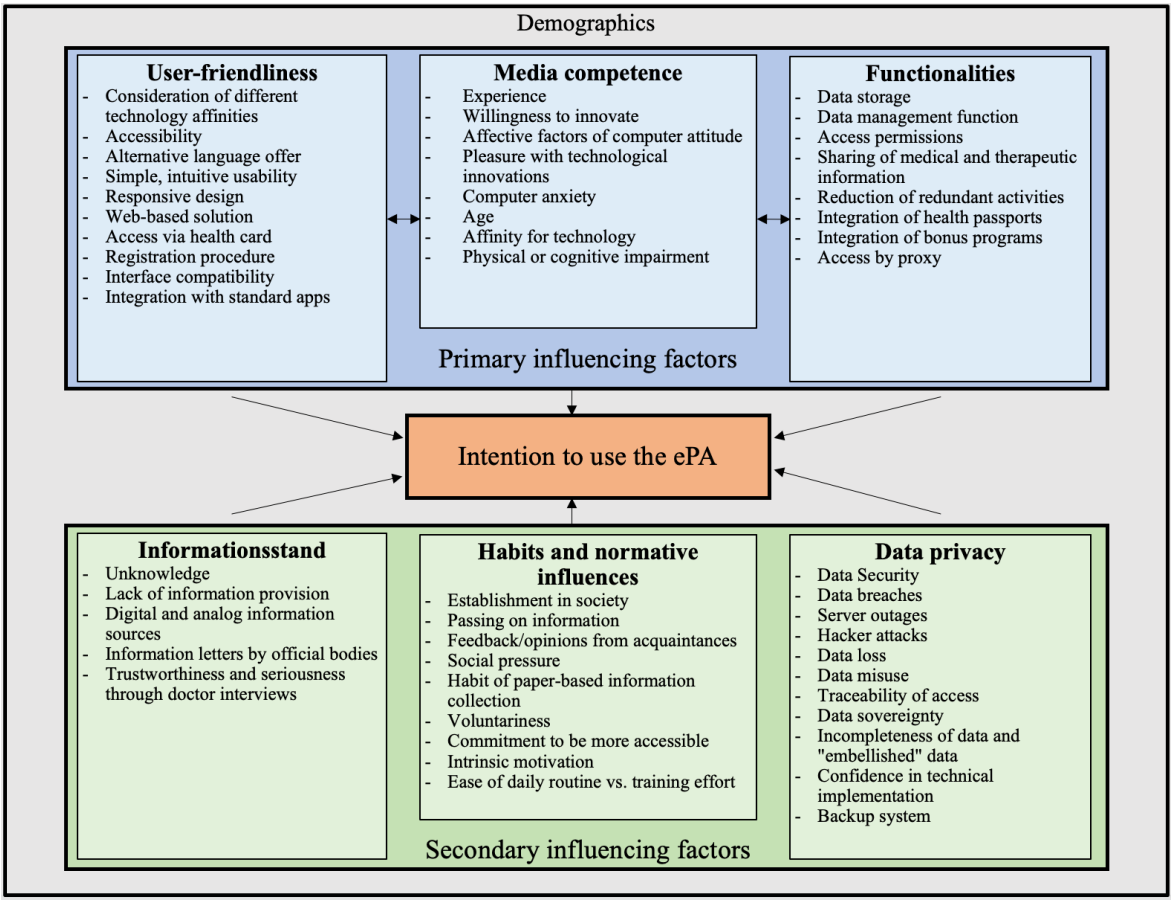

Figure 5: Factors with sub-items influencing intention to use the ePA (Kus, et al., 2022)

The respondents reached a consensus that, despite the widespread implementation of the ePA, very little information is communicated to insured individuals. For example, the acceptance of service providers was perceived as low by the interviewees, primarily due to time constraints. There has been an increasing desire for official sources to provide information and raise awareness of the ePA. This should primarily be undertaken by the treating physicians, as they can convey the necessary trust due to their direct involvement in the application.

Similar to contributions C2 and C4, the respondents underlined a certain level of change resistance among users. The ePA would only be used if its added value is clearly visible, such as improved monitoring of their own health status in the present case, and if there is a dependency. Often, social pressure motivates individuals to adopt new technologies.

However, there was no consensus on whether the use of the ePA should be mandatory. While half of the respondents advocated for mandatory use, the other half can only accept it if access is made available to older and mentally weaker individuals.

All interviewed individuals expressed concerns, particularly regarding potential disadvantages for users due to data breaches as well as the risks of technical problems and

external attacks. Additionally, patient data sovereignty was considered critical, as uncontrolled data manipulation could compromise the quality of treatment. Despite these concerns, trust was expressed in the technical implementation of the ePA, especially regarding the inclusion of an effective backup system. This inclusion reduces the risk of data loss compared to traditional paper records, which are more susceptible to external influences. These findings emphasize the importance of data privacy and security in the development and implementation of the ePA.

Dashboards serve as another source of information for end-users. Dashboards have gained prominence in the healthcare sector, particularly during the COVID-19 pandemic (cf., Figure 6). Dashboards provide insights into important metrics on a specific topic and aim to present them in a visually appealing and concise manner, allowing users to gain a comprehensive overview in the shortest possible time (Few, 2006).

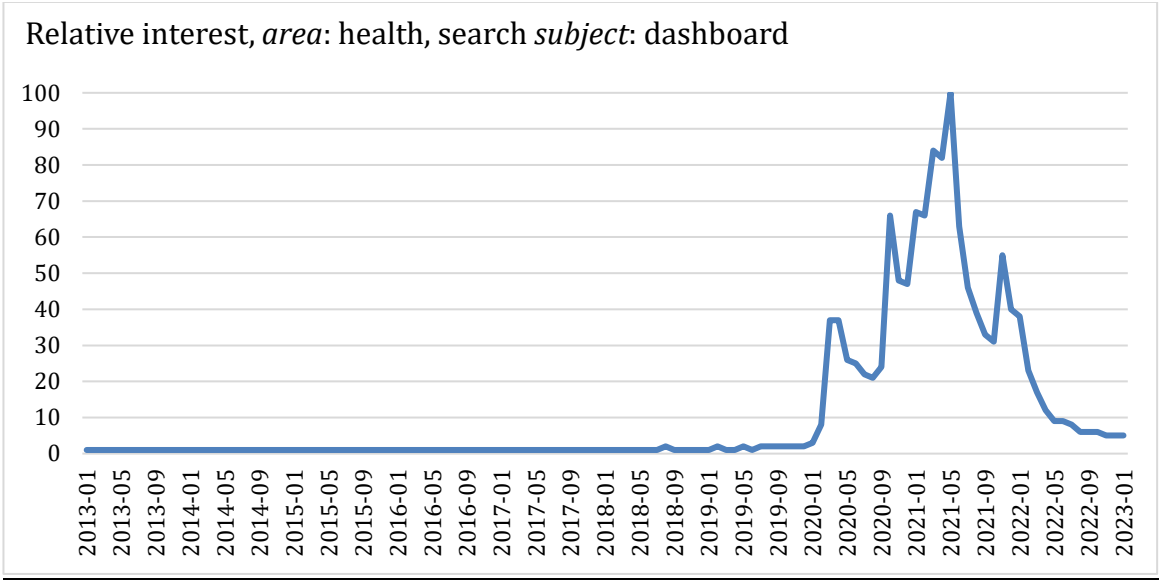

Figure 6: Distribution of the subject "dashboard" among health-related search terms (Google Trends, 2023)

Contribution C7 utilized the DSR approach and conducted an integrated user survey to investigate the acceptance factors regarding a vaccination dashboard. The results obtained provided important insights that support and expand upon the findings in contribution C6. Furthermore, the key findings highlighted that, once again, data privacy and security were among the main concerns of the users. Transparency, particularly regarding the source of information, also played a crucial role.

Furthermore, users expressed a desire for more interactivity with the dashboard, allowing them to perform their own analyses through filter functions. Additionally, there was a demand for the ability to visualize data through graphics and charts. Users emphasized the importance of the dashboard being user-friendly and accessible on various devices, including desktops, smartphones, and tablets.

A discussion of the results from contributions C6 and C7 is presented in Chapter 4 of this cumulative dissertation.

3.2.3 Visualization of intervention benefits in complex networks

Participation in digital networks does not necessarily occur due to altruistic motives, that is, the user's understanding that he or she contributes added value to the networking stakeholders and thus should take part. Therefore, considerable research has been conducted on how users can be incentivized to participate in digital networks and data traffic (Maddikunta, et al., 2022).

In the healthcare sector, the benefits arising from proactive networking have been found to be unequally distributed. This means that some stakeholders are connected to a system and have to invest as much in implementation and training as other stakeholders, but they derive fewer or hardly any benefits from using this connection. Due to this uneven distribution, some institutions have refused to adopt digital innovations, thereby hindering the functioning of the network (Arlinghaus, et al., 2023; Latour, 1996). These allocations of benefits among actors in the healthcare sector pose a significant threat to collaborative networks, especially arising from asymmetries in power, information, and conflicting objectives (Smith, 2020; Wegner, et al., 2021). A proposed approach in the scientific community has been to adjust the governance of these networks and enable access to extensive information (Wilding, et al., 2012).

One possible approach to uncovering tangible and intangible benefits within the healthcare system is knowledge visualization, which aids in breaking complex issues into key facts and establishes connections between them (Gavrilova, et al., 2019). Knowledge visualization is particularly suitable for improved involvement of various stakeholders and facilitation of knowledge dissemination. Improved collaboration among key actors and simplified communication have been described as the greatest advantages (Troise, 2022).

Contribution C8 illustrated the economic impact of using specific networking software with utility-effect chains (UEC). An adjusted approach to the original framework by Anselstetter (1984) and Schumann & Linß (1993) was employed to effectively capture the benefits for all stakeholders. The use case for implementing case management software was examined. Originally, UEC traversed various company levels along the value chain (Oesterreich & Teuteberg, 2018). In this evaluation, the company levels were replaced with different actor groups: hospitals, general practitioners, municipal providers, rehabilitation clinics, pharmacies, health insurance companies, family caregivers, and patients.

Based on the various tasks that can be performed with the software, a chain of benefits that extends across all stakeholders in the healthcare sector was created. One can speak of a kind of butterfly effect, which suggests that even small interventions can have significant downstream effects (Chehbi-Gamoura, et al., 2015).

The advantage of the methodology in contribution C8 is that UEC makes the extent of networking more comprehensible for key figures in the healthcare sector, although UEC also presents a complex network of relationships that requires consideration of many interactions (cf, Figure 7).

Through the use of CMSW, several benefits were identified for the respective stakeholder groups (see Table 7). The evaluation of CMSW underscores the importance of networking

digitally in the healthcare sector, as great potential remains untapped and numerous stakeholders can gain significant benefits from digitalization. Likewise, contribution C8 demonstrated that the participation of each actor in the healthcare sector is essential when employing networking software. The chain of benefits shown in Figure 7 is disrupted when even a single actor does not participate.

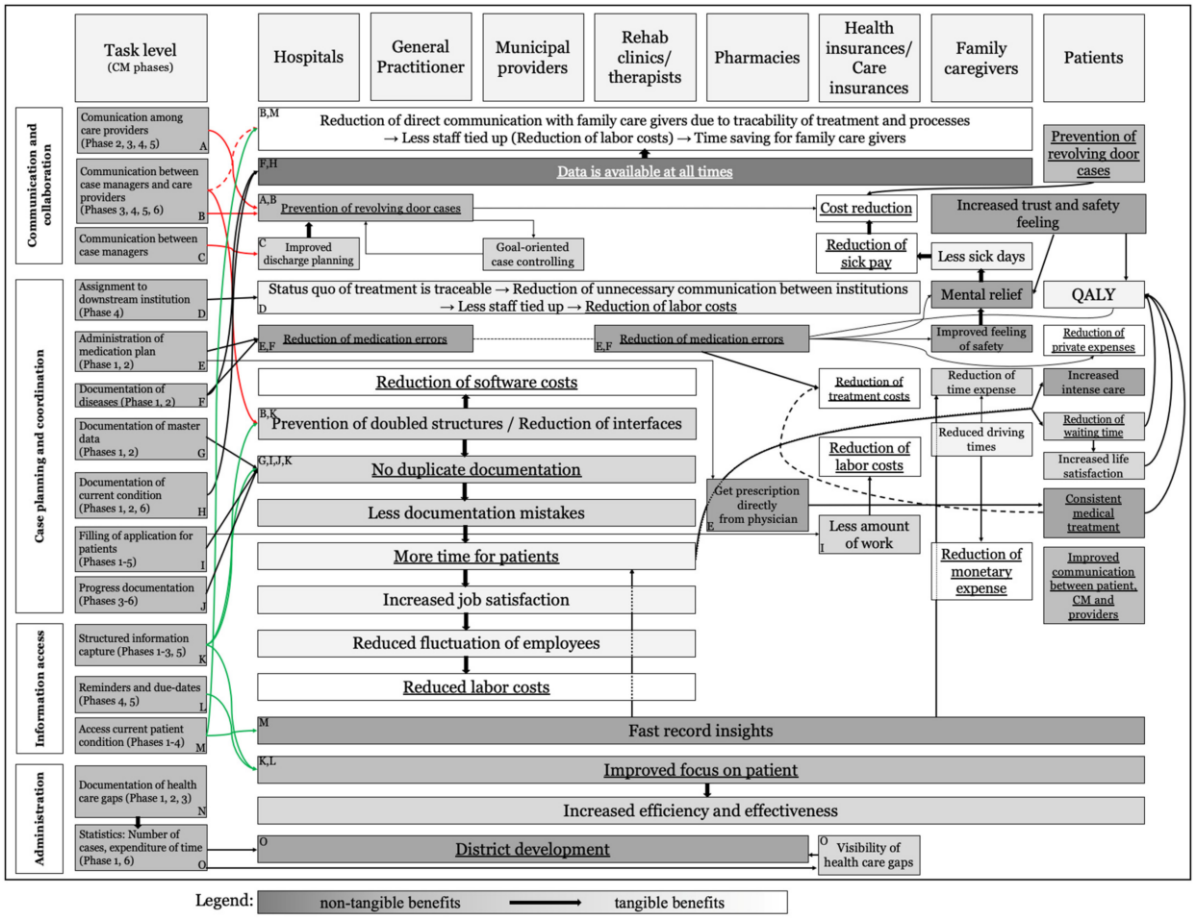

Figure 7: Utility effect chains for benefits of CMSW (Arlinghaus, et al., 2023)

Additionally, the utility of the software continuously increases as more actors use it. Documenting data for a specific patient only makes sense when all treating physicians contribute to it, thereby creating a comprehensive picture. The quality would rapidly deteriorate if data from the primary care physician were considered while documentation from hospital stays was not included.

Benefits	Stakeholders
Documentation tool as memory aid	Case managers
Constant data availability	Healthcare professionals, family caregivers, Healthcare institutions
Saving time by reduction of redundant entries of patient data, symptoms, medication, etc.	Case managers, healthcare professionals, professional caregivers

Reduction of software costs (CMSW as central software)	Healthcare institutions
Improved health related district development	Healthcare institutions, healthcare professionals
Reduced labor costs	Healthcare institutions
Improved/less unnecessary communication	Case managers, healthcare professionals, family caregivers, patients
Reduction in expenses of health insurances	Health insurance
Reduction of treatment costs for maltreatment	Health insurance, patients
Consistent medical treatment	Patients, healthcare professionals, case managers, family caregivers
Prevention of revolving door cases	Health insurances, patients, healthcare professionals
More time for patients	Patients, health insurances, healthcare professionals, case managers
Less waiting time	Patients

Table 7: Benefit identification of CMSW (Arlinghaus, et al., 2023)

The use of UEC would provide significant value for stakeholders in the healthcare sector, as it would better communicate the potential associated with the implementation of networking software. In line with Troise (2022), it would follow that stakeholders would demonstrate greater commitment to digitalization, as tangible and intangible benefits that are otherwise often hidden when considering software implementation could be better accounted for. Further implications can be found in Table 8.

No.	Implications
1	Utility effect chains can be used in healthcare to quantify benefits among various stakeholder groups.
2	Utility effect chains can be used to allocate costs for software due to the visualization of incurred added value.
3	The use of utility effect chains in healthcare helps to identify nontrivial subsequent effects of software, e.g., district development or mental relief and less private expenses for family caregivers.
4	CMSW is not an end in itself. It supports case managers in their daily work and provides a magnitude of benefits to subsequent stakeholders.
5	CMSW connects relevant partners in patient care and enables uncomplicated communication, which yields significant time saving for every involved stakeholder.
6	Using CMSW leads to a reduction in costs for all healthcare institutions.
7	The possibility to constantly gain insight into patient records and processes relieves healthcare professionals and family caregivers.
8	Preventing the repeated documentation of redundant information can be seen as a key benefit of CMSW.

Table 8: Implications of contribution C8 (Arlinghaus, et al., 2023)

4 Discussion

4.1 Implications for research

The present study encompassed a wide range of scientific methods and theoretical frameworks that contribute to the generation of new knowledge and the identification of research gaps for future exploration.
Contribution C1 successfully identified application areas for data trustees and demonstrated how they can be monetized. However, it remains a scientific task to determine how these service providers should be organized, whether advantages or disadvantages are associated with either governmental or private organization of data trusteeship, and how integration with relevant stakeholders can be achieved.
Contributions C2 and C3 focused on the barriers of AI in healthcare and were of a qualitative nature. It is of interest to ascertain, through surveys conducted among physicians, patients, and health insurance companies, which factors can support the implementation of AI in healthcare. Additionally, it would be intriguing to investigate the acceptance of AI, particularly when a mature product is available that already fulfills all the requirements for a realistic assessment of intention to use. Experiments could be the method of choice here.
A similar situation arose in contribution C4, which identified barriers to digital networking in healthcare. These barriers can be quantified using structural equation models, thereby providing a robust foundation for future research.
Contribution C5 examined the success factors of CMSW and a prototype, which incorporated all essential design principles, was developed in accordance with the DSR approach. It would be worthwhile to evaluate this prototype with other healthcare facilities to explore the possibilities of generalizing CMSW for the entire nursing sector, not only for the case management concept.
Contributions C6 and C7 addressed the acceptance of digital applications by patients. Given that the practical application of electronic health records has been limited in Germany, although electronic records have already been successfully implemented in other countries, comparative studies are necessary. Additionally, patient acceptance for health data analysis needs to be further examined. For instance, Finland practices an opt-out model, where individuals must actively dissent from the use of personal health data. By 2022, only 217 out of 5.5 million citizens filed an objection against the use of their pseudonymized data (Benrath, 2022). In this context, it would be interesting to determine whether this model would be accepted and feasible in Germany.
The economic relationships presented in contribution C8 should be quantified in future research, to assess the full potential of networking software. This quantification is of great significance not only for developers and planners of such software but can serve as an additional incentive for stakeholders in the healthcare sector. Furthermore, the adaptation of the original UEC proved to be a suitable method for representing multiple stakeholders within a system. This adaptation can be recommended to other researchers.

4.2 Implications for practice

The present cumulative dissertation aimed to elucidate the substantial challenges that hinder seamless digital networking among relevant stakeholders within the context of the German healthcare system.

The structure of the healthcare system itself proved to be a barrier, as evidenced by the successful application of the ANT (C4). There is a need to continuously reconcile a multitude of systems, interfaces, actors, institutions, regulations, guidelines, laws, and psychological constructs among patients and medical professionals. Simultaneously, it is crucial to ensure that all these components are proactively utilized. This necessitates the active engagement of all stakeholders to enable digital networking on the one hand and realize its benefits on the other (Latour, 1996). If only a fraction of the potentially participating therapists and doctors are involved, the consequence is incomplete datasets about patients or the population, which in turn can result in misinformation and erroneous conclusions.

The visualization of benefits in C8 through utility-effect chains also demonstrated the interconnectedness of actors' actions. Initially, inputs from case managers into the case management software were considered, which, in turn, provided downstream stakeholders with comprehensive datasets and helped avoid redundant therapies or examinations. Moreover, medication plans have been shown to be less prone to error and caregivers experienced temporal and mental relief (Arlinghaus, et al., 2023). However, the system has been found to reach its limits when, for example, a pharmacy does not use or refuses to use software for managing patients' medication plans. This inevitably leads to the patient record being outdated and incomplete within the digital network. The same applies when a physician lacks access to the progress data of a case management client and continues to manage their own findings in paper form, sending them via fax to the next treating physician when necessary.

In accordance with the principles of the ANT, it is imperative to integrate new actors into the existing system in the form of data trustees (C1). The absence of uniform standards, regulations, and guidelines, as well as the challenges of data integration, data quality, and data availability, have been identified as critical barriers that have hindered the widespread implementation of AI in healthcare (C2). This has been accompanied by a significant trust issue that discourages users from demanding increased adoption of AI systems. It should be noted that this trust issue can also be transferred to digital networking (C4). Although healthcare practitioners are often capable of sending emails or using networking software, significant concerns exist regarding the security of such communication channels. Healthcare professionals fear the possibility of data loss and the resulting vulnerability. Furthermore, the connection to the telematics infrastructure has not yet functioned smoothly, resulting in downstream digital solutions such as e-prescriptions being minimally utilized.

The importance of the aforementioned approaches is evident from the benefits outlined in contribution C8, which exclusively originate from the use of the employed case management software. The conducted interviews revealed that healthcare institutions are

overloaded, and integrating and embedding new digital systems into daily work routines is time-consuming. This change resistance is also due to the fact that announced solutions, such as the telematics infrastructure or e-prescriptions, cannot be smoothly utilized, leading to reliance on established structures. In this regard, it is crucial for the government to show more commitment and implement solutions persistently until the end. For instance, the e-prescription failed once again due to violations of data protection regulations, as mentioned in the background section of this dissertation (Kahl & Eckert, 2023). Hence, a new actor, namely data trustees, in the system is essential to ensure clarity and uniformity in this matter (C1).

Similarly, it is necessary to ensure increased symmetry in the distribution of added value. It is crucial for the entire system that all actors are interconnected. However, not every actor requires networking, as they are not all dependent on it. A nursing home that is consistently fully occupied, for example, does not see the need to communicate its available rooms through the network in real-time, as new residents can be found without this additional effort. However, this information can be of enormous relief to care support centers, as it enables them to provide faster assistance in emergencies and facilitate placement in a care facility.

The complex healthcare system cannot self-manage and simultaneously bring all stakeholders to the table to interconnect and persuade them of the necessity of networking. It is essential for the government to demonstrate more responsibility and allocate more resources to sustainably improve the healthcare supply through digital networks. Compensation payments for facilities that benefit less from implemented systems can be an important incentive through which digitalization is perceived as having greater added value, even if it seems ostensibly irrelevant to their own institution. However, the participation of each individual is crucial for the system as a whole.

All these points can also be applied to the design of software for patients and medical staff. A general aspiration for security has been evident when it comes to handling software in healthcare. The systems must be user-friendly, capable of detecting and indicating entry errors, and improve communication among healthcare stakeholders. This aligns with the generation of time efficiencies resulting from the software's usage (C5). Thus, the design of the software symbolizes digital networking in healthcare, as both subjects share common denominators. However, interviews regarding the software development of CMSW have revealed that acceptance was greater compared to other software because case managers were continuously involved in the development processes. Software providers as well as governmental entities should take this approach and develop solutions such as e-prescriptions or electronic patient records jointly with key users rather than imposing accomplished facts during implementation. While this may be more time and cost-intensive, such an approach promises a more sustainable effect.

Nevertheless, the case of the AI strategy and the Hospital Future Act in Germany demonstrates that the state's willingness to invest in the healthcare sector is not particularly significant compared to other sectors. For instance, approximately 4.3 billion euros have been provided for promoting digitalization within the framework of the Hospital Future Act (von Wedel, et al., 2022) and approximately 5 billion euros have been allocated for the

development of AI until 2025 (The Federal Government, 2020). However, within a few days in early 2022, 100 billion euros were approved for military upgrades due to the war between Russia and Ukraine (Engelen, 2022).

Finally, it can be concluded that healthcare users lack the motivation to implement and demand new systems. Simultaneously, they are hindered from securely utilizing these systems for their patients and in collaboration with them. Increasing amounts of data are being generated, which could be meaningfully analyzed for medical purposes. However, there has been a shortage of service providers willing to store and process this data, as well as of physicians who wish to utilize such services. Ultimately, as a major barrier, above all stands an extremely complex system that requires more support, primarily through alliances within the system but predominantly through governmental compensation payments and reforms.

Main Findings	**Implications**
RQ1: *Which factors are crucial and which conditions need to be established to advance networking and AI-driven data analysis in the German healthcare system?*	
1. The GDPR presents significant challenges for healthcare actors in terms of digital networking, data exchange, system sharing, and intelligent analysis of health data. 2. Data trustee organizations can provide a solution for ensuring compliance with legal requirements while facilitating efficient data storage and processing. 3. There is a need for data trustee organizations in research and healthcare institutions, particularly in Germany, where medical research projects struggle to find providers willing to accept and process sensitive data from vulnerable target groups. 4. The main barriers to AI adoption in healthcare include lack of standardized regulations and guidelines, interoperability and integration challenges, data quality and availability issues, technical limitations of AI algorithms, and acceptance and trust issues among health professionals. 5. There are differences in AI adoption between Germany and China, with China investing significantly more in AI and prioritizing technological development over ethical concerns. 6. The barriers to digital linking in healthcare in Germany can be categorized into six categories: security concerns, complex processes, time efficiency, discrepancy of implementation, lack of human resources, and additional work.	• To accelerate the adoption of AI in healthcare, clear regulatory frameworks, improved interoperability and integration, enhanced data quality and availability, addressing technical limitations, and promoting education and training are necessary measures. • The integration of new actors, such as data trustees, into the existing healthcare system is essential. • The implementation of uniform standards, regulations, and guidelines, as well as overcoming the challenges in data integration, quality, and availability, promote the widespread implementation of AI in healthcare. • There is a strong need for government commitment and implementation of solutions persistently until they function well for all stakeholders. • Compensation payments for facilities that benefit less from implemented systems can serve as incentives for digitalization.

RQ2: *What functional and non-functional requirements should digital solutions in the healthcare sector to increase user acceptance?*	
1. The acceptance factors for healthcare software adoption include functional factors, non-functional factors, individual factors, and environmental factors. 2. Training plays a significant role in software acceptance, with individualized training sessions recommended for less proficient user groups. Software modularity is desirable to customize the user experience and hide complex functions for unskilled users. 3. The acceptance factors for the ePA include information status, habits and normative influences, data protection, user-friendliness, media literacy, and comprehensive functionalities. 4. Insured individuals desire more information and an increase in awareness of the ePA from official sources, particularly treating physicians.	• Software design in healthcare should prioritize security, user-friendliness, error detection, and improved communication among stakeholders. • Involving key users, such as case managers, in the software development process increases acceptance and sustainability. Joint development of solutions with software providers and governmental entities is recommended. • Digital networking and data security are prerequisites for software acceptance. • Time-efficiencies are mandatory for each stakeholder group. • Physicians need to be more involved in the digitalization process in a mediating key position, owing to the deep-rooted trust that is associated with their professional image.
RQ3: *What are the economic benefits of the digital networking of stakeholders in the healthcare sector and how can these be visualized?*	
1. Benefits arising from proactive networking in the healthcare sector have been unequally distributed, leading to some stakeholders refusing to adopt digital innovations and hindering the functioning of the network. 2. Utility effect chains have demonstrated the economic impact of using networking software and shown that small interventions can have significant downstream effects. 3. The participation of each actor in the healthcare sector is essential when employing networking software. The chain of benefits is disrupted if even a single actor does not participate. 4. CMSW connects relevant partners in patient care, enables uncomplicated communication, reduces costs for healthcare institutions, and provides time efficiencies for involved stakeholders. 5. Using CMSW prevents redundant documentation, improves insight into patient records and processes, and relieves healthcare professionals and family caregivers.	• Incentivizing user participation in digital networks and data traffic is crucial, and research has been conducted to understand how users can be motivated to participate. • Knowledge visualization, such as using utility effect chains, can help uncover the benefits within the healthcare system and facilitate improved involvement of stakeholders and knowledge dissemination. • A rapid and comprehensive implementation of network software is indispensable for effectively utilizing costs and resources, thereby ensuring optimal efficiency.

Table 9: Main findings and implications regarding research questions 1–3

4.3 Limitations

Although the contributions incorporated into this cumulative dissertation have all been subject to a double-blind peer review process, they are not exempt from limitations.
As mentioned at the outset, the present work represents an exploratory research approach primarily based on expert interviews and focus groups. To enhance validity, each contribution included a systematic literature analysis, with the aim of gaining a general understanding of the topics and excluding any erroneous conclusions drawn from the interviews that deviated significantly from the existing literature. Nevertheless, the coding of the interviews was based on the authors' understanding of the respective subject matter. This was mitigated to the best possible extent by validating the coding with at least one additional person. Given that interviews were conducted, and the medical sector was addressed, the robustness of the findings could have been increased by involving a larger number of interview participants. In some cases, this was not feasible due to, for example, the limited number of data trustee providers, physicians' time constraints, and the restricted availability of case managers in the utilized use cases.
It should also be considered that the interviews were conducted exclusively with German experts, doctors, employees, and patients. Therefore, generalizability to the international context is not possible. However, this work can be used as a guide for international research.
Furthermore, it should be noted that each contribution included a systematic literature analysis based on a specific search string. Within these literature searches, both forward and backward searches were conducted. Nevertheless, it cannot be ruled out that, despite meticulous adherence to the methodology, relevant articles may have been overlooked and were not included in the analysis.

5 Conclusion

The aim of this cumulative dissertation was to examine the digital networking activity within the German healthcare system and highlight the key barriers that contribute to the comparatively slow progress in this context, particularly regarding the adoption of AI in healthcare. Additionally, the study aimed to identify acceptance factors for software in healthcare and explore how the value of networking software in healthcare can be visualized to better communicate its potential.

To address these objectives, three research questions were formulated and answered through the analysis of eight contributions, C1–8.

Research question 1, addressed by contributions C1–4, revealed significant concerns about data privacy in the digital context of the healthcare system. To overcome these concerns, the establishment of data trustee entities was proposed. These concerns extend not only to the digital networking of stakeholders but to the storage and processing of large datasets in the application of AI systems.

Contributions C5–7 formed the foundation for answering research question 2. Consistent with the findings of research question 1, it was shown that software, especially in the healthcare context, must be designed with a strong emphasis on security. Furthermore, stakeholders value simplicity and time efficiencies, as their utilization is hindered without these characteristics.

To provide a more tangible representation of the expected benefits, utility-effect chains were employed in contribution C8. The utilization of this dedicated case management software resulted in diverse benefits for the relevant stakeholders in healthcare, which can be better comprehended through these chains.

Overall, it is important to note that stakeholders in the healthcare sector are not generally opposed to digital networking. However, a foundation must be established that instills a sense of security for all actors involved and enables data exchange without compromising patient privacy rights. The state has been identified as the responsible entity that must consider all stakeholders in its plans. It is crucial to establish uniform structures to prevent the proliferation of incompatible individual solutions.

The author of this dissertation hopes that this work contributes to increased investment in digital structures and a more systematic approach to digital infrastructure. The potential in healthcare is evident, but the complex system requires a leading entity capable of balancing asymmetries and courageously implementing reforms regarding data privacy.

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Part B: Research Contributions

Contribution 1

Contribution 1	
Title	Datentreuhandstellen gestalten: Status quo und Perspektiven für Geschäftsmodelle
Authors	Tim Arlinghaus, Kevin Kus, Patricia Kajüter, Frank Teuteberg
Year	2021
Medium	Journal
Outlet	HMD Praxis der Wirtschaftsinformatik
Ranking	VHB-JOURQUAL 3: D WKWI: B
Bibliographic information	Arlinghaus, T., Kus, K., Kajüter, P., & Teuteberg, F. (2021). Datentreuhandstellen gestalten: Status quo und Perspektiven für Geschäftsmodelle. HMD Prax. Wirtsch., 58(3), 565-579.
Identification	DOI: 10.1365/s40702-021-00727-x ISSN: 2198-2775
Link	https://link.springer.com/article/10.1365/s40702-021-00727-x
Abstract	Dealing with large data volumes presents major challenges to companies when it comes to designing secure digital processes, especially when personal or sensitive data need to be processed. This applies equally to research projects, where data must be handled with the highest level of protection and sensitivity. Data trustees can be used to ensure this high level of data protection and compliance with ethical guidelines. In the meantime, some use cases of private trustees are known, which promise noticeable added value for companies. This article provides initial insights into the business models of data trustees as well as their areas of application. For this purpose, the Digital Canvas was used, which postulates nine pillars of digital business models. In addition, differences between governmental and commercial providers are analyzed as well as the potential of data trustees are highlighted and it is shown that their services will increasingly gain demand in the future. The findings are based on six expert interviews conducted with the heads of data trustees already operating in Germany.

Contribution 2

Contribution 2	
Title	How to Overcome the Barriers of AI Adoption in Healthcare: A Multi-Stakeholder Analysis
Authors	Tim Arlinghaus, Kevin Kus, Patricia Kajüter, Alina Behne, Frank Teuteberg
Year	2022
Medium	Conference Proceedings
Outlet	26th Pacific Asia Conference on Information Systems, PACIS 2022; Taipei, Taiwan
Ranking	VHB-JOURQUAL 3: C WKWI: B
Bibliographic information	Arlinghaus, T., Kus, K., Behne, A., & Teuteberg, F. (2022). How to Overcome the Barriers of AI Adoption in Healthcare: A Multi-Stakeholder Analysis.
Identification	DOI: ISSN:
Link	https://aisel.aisnet.org/pacis2022/4/
Abstract	We present barriers of AI adoption in healthcare on macro to micro level and respective actions to overcome these challenges for each stakeholder group. The findings are verified with results from literature. We used two qualitative methods:(1) a systematic literature review and (2) expert interviews with seven AI experts and nine physicians. We applied a deductive coding scheme. The barriers can be classified in social, ethical, political, economic, technological, educational and organizational barriers. The findings provide that the most hindering barriers are of technological, political and organizational nature. Social and economic barriers are less difficult to overcome, in particular when the benefits of AI application become apparent in practice. From our results, we infer the following four actions: enlightment, regulation, incentives and collaboration. We linked all derived actions with the identified barriers and stakeholders. Thus, we provide a guidance to overcome the adoption barriers of AI in healthcare.

Contribution 3

Contribution 3	
Title	Analyzing Healthcare AI Adoption in China and Germany under the Lens of the Socio-Technical Theory: A Literature Analysis
Authors	Kevin Kus, Tim Arlinghaus, Frank Teuteberg
Year	2022
Medium	Conference Proceedings
Outlet	26th Pacific Asia Conference on Information Systems, PACIS 2022; Taipei, Taiwan
Ranking	VHB-JOURQUAL 3: C WKWI: B
Bibliographic information	Kus, K., Arlinghaus, T., & Teuteberg, F. (2022). Analyzing Healthcare AI Adoption in China and Germany through the Lens of Socio-Technical Theory: A Literature Analysis.
Identification	DOI: ISSN:
Link	https://aisel.aisnet.org/pacis2022/126
Abstract	Even though artificial intelligence (AI) has great potential in several sectors, AI adoption in healthcare remains a difficult topic facing several challenges. In addition to the difficulties posed by the technology itself, there are challenges in the social sphere, involving both structural and individual components. Some nations are at the forefront of implementing AI in healthcare compared to others. To date, little AI research considers socio-technical dimensions to explain differences in healthcare AI adoption between countries. We address this research gap by identifying and analyzing challenges by applying the socio-technical theory (STT) with a focus on Germany and China. Some adoption challenges occur independently of national context, whereas others must be considered in the context of country characteristics. In addition, we discuss reasons for the varying adoption rates between Germany and China, include national culture dimensions and suggest propositions for national healthcare AI implementation strategies.

Contribution 4

Contribution 4	
Title	Analysis of Barriers to Digital Linking among Healthcare Stakeholders
Authors	Patricia Kajüter, Tim Arlinghaus, Kevin Kus, Frank Teuteberg
Year	2022
Medium	Conference Proceedings
Outlet	Wirtschaftsinformatik 2022 Proceedings. 7
Ranking	VHB-JOURQUAL 3: C WKWI: A
Bibliographic information	Kajüter, P.; Arlinghaus, T.; Kus, K.; and Teuteberg, F., "Analysis of Barriers to Digital Linking among Healthcare Stakeholders" (2022). Wirtschaftsinformatik 2022 Proceedings. 7.
Identification	DOI: - ISBN:
Link	https://aisel.aisnet.org/wi2022/digital_health/digital_health/7
Abstract	Digitization affects all areas of public and work life - people connect with friends, family, colleagues, and businesses and exchange data with each other every day via apps and platforms. However, digitization in the healthcare sector is lagging far behind. Instead of exchanging data digitally and striving for efficient digital linking, the healthcare sector often uses the telephone or fax as a means of data exchange. By conducting a case study on the German healthcare sector, this paper identifies six categories of barriers that inhibit digital linking in healthcare: individual, legal, financial, institutional, technological, and workforce-related barriers. They are analyzed using the dimensions of level, IT influence, and perception and applying the actor-network theory.

Contribution 5

Contribution 5	
Title	Success factors of Case Management software supporting healthcare patient services - A user-driven perspective
Authors	Kevin Kus, Tim Arlinghaus, Patricia Kajüter, Frank Teuteberg
Year	2021
Medium	Conference Proceedings
Outlet	Proceedings of the 27th Americas Conference on Information Systems (AMCIS 2021)
Ranking	VHB-JOURQUAL 3: D WKWI: B
Bibliographic information	Kus, K., Arlinghaus, T., Kajüter, P., & Teuteberg, F. (2021). Success Factors of Case Management Software Supporting Healthcare Patient Services-A User-Driven Perspective. In: Proceedings of the 27th Americas Conference on Information Systems (AMCIS 2021)
Identification	DOI: - ISBN:
Link	https://aisel.aisnet.org/amcis2021/healthcare_it/sig_health/22
Abstract	Technological development captures almost every sector and affects most people regarding their job life. This implies challenges such as implementing software supporting work processes. With regard to these challenges, the healthcare sector stands out due to necessary restructuring resulting from demographic changes and a lack of employees. To overcome this struggle and to provide optimal treatment for care recipients, customized case management software (CMSW) solutions for healthcare professionals need to be developed and adapted to the users' needs. By analyzing literature dealing with the users' acceptance of software supporting healthcare patient services and interviewing six case managers who use recently developed CMSW, we identify success factors for the implementation of CMSW from a user's perspective. Our findings show that CMSW needs to include both core functionalities such as documentation and the specific case management phases. Also, users should participate in the CMSW development process.

Contribution 6

Contribution 6	
Title	Die elektronische Patientenakte als zentraler Bestandteil der digitalen Transformation im deutschen Gesundheitswesen - Eine Analyse von Akzeptanzfaktoren aus Patientensicht
Authors	Kevin Kus, Patricia Kajüter, Tim Arlinghaus, Frank Teuteberg
Year	2022
Medium	Journal
Outlet	HMD Praxis der Wirtschaftsinformatik
Ranking	VHB-JOURQUAL 3: D WKWI: B
Bibliographic information	Kus, K., Kajüter, P., Arlinghaus, T., & Teuteberg, F. (2022). Die elektronische Patientenakte als zentraler Bestandteil der digitalen Transformation im deutschen Gesundheitswesen–Eine Analyse von Akzeptanzfaktoren aus Patientensicht. HMD Praxis der Wirtschaftsinformatik, 1577-1593.
Identification	DOI: 0.1365/s40702-022-00921-5 ISSN: 2198-2775
Link	https://link.springer.com/article/10.1365/s40702-022-00921-5
Abstract	Demographic change and the shortage of specialists in medical and nursing care pose major challenges for the German healthcare system. The electronic health record (EHR), as a central component of digitization in the healthcare system, is intended to support data exchange between the stakeholders, relieve healthcare service providers, and at the same time leave data sovereignty with the patient. In addition to the required IT specialists, the acceptance of the stakeholders, which include the service providers and patients, is of decisive importance for successful EHR adoption. In our analysis, we focus on the factors influencing the intention to use EHR from the patients' perspective, very few of whom have used EHR so far. After an explanation of the EHR and the inclusion of relevant literature, 16 semi-structured interviews with patients are conducted to obtain practical insights from (potential) users. Based on this, a category system of acceptance factors influencing EHR use from the patient's point of view is developed. Six acceptance factors are identified: (1) level of information, (2) habits and normative influences, (3) data protection, (4) user-friendliness, (5) media competence, and (6) functionalities. The analysis results are used to derive recommendations for action for EHR providers that can lead to greater EHR acceptance from the patient perspective. Our research makes an important contribution to which factors have to be considered in the development and provision of EHR from the patient's perspective and how potential problems of this user group can be solved.

Contribution 7

Contribution 7	
Title	Vaccination Dashboard Development during COVID-19: A Design Science Research Approach
Authors	Kevin Kus, Ludger Pöhler, Patricia Kajüter, Tim Arlinghaus, Frank Teuteberg
Year	2022
Medium	Conference Proceedings
Outlet	17th International Conference on Wirtschaftsinformatik (WI 2022)
Ranking	VHB-JOURQUAL 3: C WKWI: A
Bibliographic information	Kus, K.; Poehler, L.; Kajüter, P.; Arlinghaus, T.; Teuteberg, F. (2022): Vaccination Dashboard Development during COVID-19: A Design Science Research Approach; Proceedings der 17. Internationalen Tagung Wirtschaftsinformatik (WI 2022); Nürnberg, Germany.
Identification	DOI: - ISSN: -
Link	https://aisel.aisnet.org/wi2022/digital_health/digital_health/10
Abstract	The COVID-19 pandemic has affected the lives of people worldwide since the beginning of 2020. Since vaccines against COVID-19 have become available, the issue of vaccination has become increasingly important. Accordingly, vaccination dashboards are provided to inform the public about COVID-19 vaccination developments. In our study, we used a design science research (DSR) approach to explore what information vaccination dashboards should provide and how they should be designed. In addition to an initial literature review, we analyzed existing vaccination dashboards and derived information categories. Thereafter, we conducted an online survey to identify the most important metrics from a user's perspective. Our results indicate that, in addition to vaccination coverage, a comparison of vaccination efficacy and side effects is important. Subsequently, a click prototype was developed and expert interviews were carried out to determine how vaccination dashboards should be designed and which technical issues should be considered.

Contribution 8

Contribution 8	
Title	Visualizing Benefits of Case Management Software Using Utility Effect Chains
Authors	Tim Arlinghaus, Kevin Kus, Patricia Kajüter Rodrigues, Frank Teuteberg
Year	2023
Medium	Journal
Outlet	Sustainability
Ranking	VHB-JOURQUAL 3: C JIF: 4.17
Bibliographic information	Arlinghaus, T., Kus, K., Kajüter Rodrigues, P., & Teuteberg, F. (2023). Visualizing Benefits of Case Management Software Using Utility Effect Chains. Sustainability, 15(6), 4873.
Identification	DOI: 10.3390/su15064873 ISSN: 2071-1050
Link	https://www.mdpi.com/2071-1050/15/6/4873
Abstract	Labor shortages lead to crucial investment decisions, such as selecting software supporting work processes. The healthcare sector stands out because of additional restructuring due to demographic changes. This is particularly true for the care sector; hence, customized case management software (CMSW) solutions for healthcare professionals are being developed. In an increasingly profit-oriented healthcare system, sustainability, cost-effectiveness and quantification of benefits of investments play a major role. We analyzed research dealing with the benefits of case and care management software and, additionally, interviewed case managers who use recently developed CMSW within a case study. We used utility effect chains to visualize and quantify the gathered benefits of an information system (IS) investment along with the healthcare system in Germany. The findings show that benefits from care management software need to be seen more holistically. Utility effect chains can serve as a helpful instrument for the visualization of indirect benefits in healthcare. The most significant benefits of CMSW were found to be various cost savings for each of the participating stakeholders, a reduction in redundant entries of patient data and the prevention of cost-intensive revolving door cases. Additionally, the insight into patient records reduces time-consuming communication among health experts and family caregivers.