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Introduction

1.1 Motivation

Information-intensive consumer-oriented services

Ubiquitous computing[1] [2] is a technological paradigm that extended the world of information and communication technology from anytime, anyplace connectivity for anyone to connectivity for anything[3]. The resulting technological developments, such as Internet of Things and cloud computing, enabled *consumer-oriented information-intensive services*[4].

> For an information-intensive service, activities such as information processing or information exchange account for the greatest portion of value creation compared to physical or interpersonal activities.[5]

Value is created by the co-creation of knowledge. Knowledge co-creation is based on division of labor between two or more actors. Each actor participates in the learning process by sharing existing knowledge as well as information collection and processing in order to create new knowledge.[6] Knowledge co-creation differs from the provision of knowledge, since the latter is the consumption of existing

[1] "Ubiquitous computing has as its goal the non intrusive availability of computers throughout the physical environment [...] invisible to the user. [...] ubiquitous computing will be a world of fully connected devices, with cheap wireless networks; [...] information will be accessible everywhere." Weiser, 'Hot topics-ubiquitous computing', 1993, p. 71

[2] The resulting smart environment is described as "richly and invisibly interwoven with sensors, actuators, displays, and computational elements, embedded seamlessly in the everyday objects." Weiser, Gold and Brown, 'The origins of ubiquitous computing research at PARC in the late 1980s', 1999, p. 694

[3] International Telecommunication Union, *ITU Internet Reports 2005: The Internet of Things - Executive Summary*, 2005, p. 2

[4] The Internet of Things and cloud computing were identified as critical technological developments to achieve ubiquitous computing. The Internet of Things describes a network of interconnected objects, which not only monitor the physical world and interact with it, but also use existing Internet standards to provide services for information transfer. Cloud computing is considered the framework, which unifies the Internet of Things, data analytics and, information presentation. Gubbi et al., 'Internet of Things (IoT): A vision, architectural elements, and future directions', 2013, pp. 1645-1646

[5] Apte and Mason, 'Global disaggregation of information-intensive services', 1995, p. 1254

[6] Fuchs-Kittowski, 'Wissens-Ko-Produktion - Organisationsinformatik: Verarbeitung, Verteilung und Entstehung von Informationen in kreativ-lernenden Organisationen', 2010, p. 14

knowledge. Knowledge co-creation results in the creation of innovative solutions or practical knowledge.[7] Information and Communication Technology (ICT) is considered the key element to co-create knowledge.[8]

> Consumer-oriented services are services that fulfill needs that arise during the life cycle of interaction with the provider of the service.[9] The recipient of the service is a private individual and the service provider can be human or non-human. Furthermore, the consumer is transformed by the experience of consuming the service[10].

A simple example of an information-intensive consumer-oriented service is a mobile application, e.g. a weather app or location-based advertisement. A more complex example is a network of different human and non-human actors providing a more elaborate service than the traditional information or entertainment service. An example from health care is telehealth applications: A patient's rehabilitation exercises at home are monitored and ICT reliant instruction and exercise equipment are adapted based on the measured progress. Furthermore, the collected vital parameters are transferred to the patient's doctor, who conducts the next physical examination based on the monitored data. In addition to health care, other typical application areas are government, finance, insurance, or education[11]. **In summary, information-intensive consumer-oriented services strongly depend on ICT and exhibit a complex multi-design context where value is created in person-to-person interactions and ICT reliant interactions. ICT reliant interactions can range from self-services (e.g. online exercise scheduling tool) to a mix of person-to-person interactions with different degrees of ICT involvement (e.g. web conference with medical professional).[12] [13]**

Market opportunities for individualization

The problem of information-intensive services[14] is that they are easily imitated and companies face the issues of a decreasing annual growth rate of new consumers. As a result, competition to win consumers turned to a strategy of individualiza-

[7] Fuchs-Kittowski, 'Wissens-Ko-Produktion - Organisationsinformatik: Verarbeitung, Verteilung und Entstehung von Informationen in kreativ-lernenden Organisationen', 2010, p. 9

[8] see page 47

[9] Kim and B. Lee, 'E-service quality competition through personalization under consumer privacy concerns', 2009, p. 182

[10] Teboul, *Service is front stage: positioning services for value advantage*, 2006, pp. 12-14

[11] Kratochvíl and Carson, *Growing Modular - Mass customization of complex products, services and software*, 2005, p. 35

[12] Riedl, Leimeister and Krcmar, 'Why e-Service Development is Different: A Literature Review', 2011, pp. 8

[13] Glushko, 'Seven Contexts for Service System Design', 2010, p. 219

[14] For matters of comprehension the term *service* is used synonymously with *consumer-oriented service* throughout the whole thesis.

tion.[15] [16] [17] [18] Individualization focuses on meeting demands of individuals rather than groups of customers. A Gartner report predicts that by 2020, there will be 309 billion dollars in incremental revenue opportunity for highly individualized services. The forecast excludes mobile devices such as laptops, tablets or smartphones.[19] Nonetheless, mobile devices are expected to become individualized as well, i.e. mobile devices will know their user's unique preferences and tailor mobile applications accordingly[20]. "By 2020, over 50% of consumer mobile interactions will be in contextualized, "hyperpersonal" experiences based on past behavior and current, real-time behavior. By 2021, 50% of apps will trigger events for users, thereby making them more efficient."[21]. Furthermore, "Gartner said that brands and businesses are already using mobile apps as a primary component of their user engagement strategies, and as the use of mobile devices, including wearable devices, expands into other areas of consumer and business activities, mobile apps will become even more significant" and "will impact a wider set of devices, from home appliances to cars and wearable devices" For instance, wearable devices will use mobile applications for data exchange and as their user interface."[22]

Implications of individualization

Individualization has been studied extensively in marketing research. Marketing research propagates a strategy called one-to-one marketing, which essentially is segmentation to a segment size of one. "Instead of selling one product at a time to as many customers as possible in a particular sales period, the 1:1 marketer uses customer databases and interactive communication to sell one customer at a time as many products and services as possible, over the entire lifetime of that customer's patronage."[23] The goal is to improve knowledge about the consumer to offer him/her as many services as possible. One-to-one marketing and individualization have in common that they strive for better knowledge about a consumer's needs. However, the application of that knowledge differs. One-to-one marketing aims at an improved promotion of services. Individualization goes deeper and addresses the improvement of value proposition by adapting the service to a consumer's needs (see figure 1.1). In this context, service features which are most relevant to a consumer need to be identified. Simultaneously, it has to be verified, what a provider can make available. Finally, an optimal match between these two sets

[15] R. Meier and T. F. Piller, 'Systematisierung von Strategien zur Individualisierung von Dienstleistungen', 2001, p. 6

[16] Voxeo, *The Power of Personalization : Optimizing Customer Self-Service for Increased Loyalty and Cost Savings " You want to go where everybody knows your name ."* 2012, p. 11

[17] Oracle, *How to Win Online : Advanced Personalization in E-Commerce*, 2011, p. 2

[18] Porter and Heppelmann, 'How smart, connected products are transforming companies', 2015

[19] Gartner, *Gartner Says the Internet of Things Installed Base Will Grow to 26 Billion Units By 2020*, 2013

[20] McKinsey&Company, *A new era of personalized computing*, 2012, p. 46

[21] Laney and Jain, *100 Data and Analytics Predictions Through 2021*, 2017

[22] Gartner, *Gartner says by 2017, mobile users will provide personalized data streams to more than 100 apps and services every day*, 2014

[23] Peppers and Martha, *Enterprise one to one: Tools for competing in the interactive age*, 1996, p. xxi

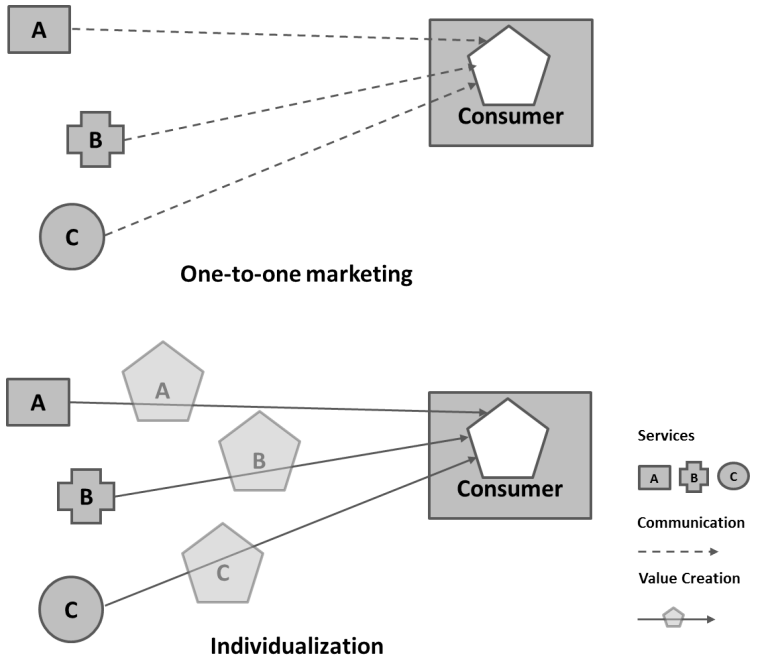

Figure 1.1: *One-to-one marketing vs. individualization, Source: own representation*

needs to be found. Therefore, evaluation mechanisms for consumer and provider information and matching mechanisms are important. In this context, technological developments can provide the necessary support, since the interaction with a consumer is automated and information about the consumer can be collected and analyzed in real time[24]. On the downside, information overload becomes a greater issue for consumers. Information overload for consumers occurred initially in a purchase situation where a consumer had to choose between different services[25]. With individualization consumers have to choose a specification of service features, which creates additional complexity[26]. In this context, consumers might lack the knowledge (e.g. about his/her preferences) and skills (e.g. mechanisms to evaluate service features) to make a suitable decision[27]. Furthermore, technology itself can cause information overload[28]. Overall, individualization affects the design of the service infrastructure, the design of the service production and delivery process, and the interaction system with the customer[29]. From an engineering perspective the following questions arise with individualization:

- What information about the consumer should be collected and how (information source, implicit vs. explicit)?

[24] Leimeister, *Dienstleistungsengineering und -management*, 2012, p. 46
[25] Eppler and Mengis, 'The concept of information overload: A review of literature from organization science, accounting, marketing, MIS, and related disciplines', 2004, p. 291
[26] Huffman and Kahn, 'Variety for sale: Mass customization or mass confusion?', 1998, p. 494
[27] Frank T. Piller, 'Mass Customization: Reflections on the State of the Concept', 2005, p. 324
[28] S. Jarvenpaa and Lang, 'Managing the paradoxes of mobile technology', 2005, p. 492
[29] Frank Thomas Piller and M. M. Tseng, 'Introduction and overview', 2010, p. 592

- How is knowledge about the consumer generated (simple tracking of a consumer vs. elaborate reasoning mechanisms)?
- How can providers match service features to consumers' preferences?
- How can consumers be supported in coping with increased information overload?

Research approach

The questions demonstrate that in addition to the traditional provider perspective, a consumer perspective needs to be adopted for the design of individualized information-intensive services[30] [31] [32]. Approaches for designing individualized information-intensive services face the issue that they have only recently become an object of study in the area of services and intangible products[33] [34]. Furthermore, they do not provide sufficient support for the characteristics of information-intensive services[35] [36]. From a consumer perspective, personalization approaches applied in recommender systems research provide a possible solution[37] [38]. Recommender systems support decision-making by individuals and are of particular use in electronic commerce[39]. However, approaches are mainly examined on a method-oriented level[40] [41]. Since the outcome heavily depends on the consumer, a focus beyond the method-oriented level is required. In this context, no formalized model exists that incorporates a holistic approach[42] [43]. **Therefore, the goal of this thesis is**

[30] Sampson and Froehle, 'Foundations and Implications of a Proposed Unified Services Theory', 2006, p. 340

[31] Michalski, 'Strategische Entwicklungsperspektiven von innovativen wissensintensiven Dienstleistungsangeboten in Wertschöpfungsnetzwerken', 2003, p. 66

[32] Nägele and Vossen, 'Erfolgsfaktor kundenorientiertes Service Engineering - Fallstudienergebnisse zum Tertiarisierungsprozess und zur Integration des Kunden in die Dienstleistungsentwicklung', 2006, p. 540

[33] Frank Thomas Piller and M. M. Tseng, 'Introduction and overview', 2010, p. 16

[34] R. Meier and T. F. Piller, 'Systematisierung von Strategien zur Individualisierung von Dienstleistungen', 2001, p. 14

[35] Menschner, Peters and J.M. 'Engineering knowledge-intensive, person-oriented services - A state of the art analysis', 2011, p. 1

[36] Riedl, Leimeister and Krcmar, 'Why e-Service Development is Different: A Literature Review', 2011, p. 23

[37] Felfernig, Friedrich and Schmidt-Thieme, 'Guest Editors' Introduction: Recommender Systems', 2007, p. 20

[38] Ch. Vassiliou, Stamoulis and Martakos, 'A review of potential technologies and user functionality of personalized e-services', 2001, mentioned in Kardaras and Karakostas, 'Introduction', 2012, p. xxix

[39] **Electronic commerce** means the initiation, arrangement, and conduction of service exchange with the help of public or private communication networks, including the Internet. A. Meier and Stormer, *eBusiness & eCommerce*, 2009, p. 2 It is considered the part of electronic business which refers to the coordination and integration of business, communication and transaction processes on the market and company level via ICT and network technologies. Weiber, *Handbuch Electronic Business: Informationstechnologien - Electronic Commerce - Geschäftsprozesse*, 2002, pp. 1061-1065

[40] Baltrunas et al., 'Context relevance assessment and exploitation in mobile recommender systems', 2011, p. 508

[41] Ricci, 'Mobile Recommender Systems', 2011, p. 223

[42] J. C. Spohrer, Gregory and Ren, 'The Cambridge-IBM SSME White Paper Revisited', 2010, p. 686

[43] Kardaras and Karakostas, 'Introduction', 2012, p. xxxv

to develop a consumer-oriented approach for the design of individualized information-intensive services.

1.2 Domain-specific positioning

Health care market developments

The health care value network is considered one of the most complex value creation networks. It consists of enterprises from the private and public sector, as well as academia and non-profit organizations. Despite the variety of organization types, no single type of enterprise dominates the network.[44] Demographic change, the increase in lifestyle-dependent diseases such as obesity, and the resulting cost explosion in public health care triggered German health care policy to put more emphasis on disease prevention and well-being promotion[45]. Briefly summarized, the goal is to keep healthy individuals healthy, this is called primary prevention. Primary prevention services are not necessarily provided via the public health care market but mainly via the private health care market. The two markets are not mutually exclusive, but overlap. Diet and physical activities have been identified as promising areas of growth for primary prevention services [46]. Several industry studies consider patient-centricity and information services to be core aspects of the future health care market[47] [48] [49]. Smart mobile devices and applications in combination with cloud computing, social networking and big data analytics are considered to be major levers for the expected changes of the health care market. Furthermore, wearable devices for tracking body parameters in combination with mobile applications on smartphones are at the core of mobile health applications or mHealth applications. The mHealth market has been growing steadily over the last years. In 2017 there were 325.000 health apps (health & fitness and medical apps) on all major app stores, resulting in estimated 3,7 billion downloads.[50]

Primary disease prevention and well-being services

The expected developments in the health care market exhibit what is called digitalization of core service functionalities. This means that important value-creating features of a service are digitalized[51]. **From a domain-specific point of view it means that support with decisions about a healthy lifestyle is expected**

[44] Basole and Rouse, 'Complexity of service value networks: Conceptualization and empirical investigation', 2008, p. 62

[45] A law called "Präventionsgesetz" was passed in 2015 about the promotion of disease prevention. Bundesministerium für Gesundheit, *Präventionsgesetz*, 2017

[46] Hietala et al., *PHS in Primary Prevention: Business models and technical requirements Deliverable 3.1*, 2009, pp. 76-78

[47] Ernst and Young, *mHealth: Mobile technology poised to enable a new era in health care*, 2012, p. 7

[48] Ernst and Young, *Progressions Global Life Science Report 2012 - The third place: health care everywhere*, 2012, p. 16

[49] PricewaterhouseCoopers, *HealthCast - Die Individualisierung des Gesundheitswesen*, 2010, p. 13

[50] Pohl, *mHealth App Economics 2017/2018*, 2017

[51] Ralf Reichwald, Frank T. Piller and R. Meier, 'E-Service Customization: Strategien zur effizienten Individualisierung von Dienstleistungen', 2002, p. 231

to become an individualized information-intensive service. The described transformation of a consumer by "experiencing" an information-intensive service in this context is called health literacy. It is defined as "[...] people's knowledge, motivation and competences to access, understand, appraise, and apply health information in order to make judgments and take decisions in everyday life concerning health care, disease prevention and health promotion to maintain or improve quality of life during the life course."[52] Therefore, individualization of information-intensive services in the context of primary disease prevention and well-being services is highly relevant. Furthermore, developments in the private health care market can be considered a petri dish for studying individualization of information-intensive services in the overall health care market since public and private health care markets overlap. **Due to the social relevance and the predicted economic opportunities, the focus is on primary disease prevention and well-being services in terms of applicability of the conceptual framework, the implementation of the prototype and its evaluation described in this work.**

1.3 Problem statement

Information-intensive services exhibit a complex design context. Therefore, individualization needs to be analyzed in relation to the characteristics of information-intensive services:

Research Question 1
What are the characteristics of individualization of information-intensive services? What are core design aspects for individualization of information-intensive services?[53]

Success of individualized information-intensive services is highly dependent on the consumer. Therefore, a consumer-oriented design approach which extends existing approaches is required:

Research Question 2
What can existing approaches contribute to the design of individualized information-intensive services?[54]

[52] K. Sørensen et al., 'Health literacy and public health: a systematic review and integration of definitions and models', 2012, p. 3

[53] It is established that only a value-oriented view on information-intensive services provides the required consumer centricity for individualization of information-intensive services (see page 43). The complex design context is analyzed and the artefact value-in-context is further developed which provides the required value orientation (see page 44). Furthermore technological design aspects of individualization are derived (see page 80)

[54] Hedonic information (see page 50) systems and individual information systems (see page 54) are introduced as relevant design approaches and provide the basis for the design of the conceptual framework (see page 122).

Having specified individualization and analyzed feasible design approaches, a new approach is constructed for the design of individualized information-intensive services:

Research Question 3
What are the requirements for the indivdualization of information-intensive consumer-oriented services? What does a conceptual framework look like?[55]

The final research question looks into applying the conceptual framework:

Research Question 4
How can the conceptual framework be applied for the individualization of disease prevention and well-being services? How is the resulting prototype implemented and evaluated?[56]

The conceptual framework to be developed ensures, on the one hand, that the most relevant service features are identified and matched to an individual consumer. On the other, it allows for an efficient resource and process implementation on the provider side. Overall, the conceptual framework allows the common use of resources and processes for different individuals. It therefore contributes to the organization of information and processes and thus is conducive to the design of individualized information-intensive services.

1.4 Scientific positioning

Multidisciplinary approach

Services reside in a system of a dynamic value-creating configuration of people, organization and technology[57]. This definition is very similar to the socio-technical notion of an information system examined within Wirtschaftsinformatik[58] which is the guiding research discipline of this thesis. The analysis of systems of people, technology, and organization locates Wirtschaftinformatik at the interface of business administration, computer science and sociology[59]. This thesis touches on all three research disciplines. In terms of computer science, methods from recommender systems research are analyzed. Furthermore, design approaches focused on individualization are examined from a service engineering perspective. Due to the strong focus on the consumer, this thesis also touches on marketing research and psychology. In the spirit of multidisciplinarity related domain-specific eHealth

[55] A theoretical and application-oriented point of view is adopted for the requirements analysis (see page 115). The results are combined with the technical design aspects for individualization of information-intensive services (see page 118). A conceptual framework is introduced and related with the identified requirements (see page 128).

[56] An architectural framework for disease prevention and well-being services based on the conceptual framework is provided an page 128. The MENTORbike system (see page 196) represents an instantiation of the architectural framework. Descriptions of the implementation and evaluation finalize the proof of concept

[57] J. Spohrer et al., 'Steps toward a science of service systems', 2007, p. 72

[58] Buhl et al., 'Service Science', 2008, p. 64

[59] Scheer, *ARIS — Business Process Frameworks*, 1999, p. VII

approaches are investigated as well. Overall, Wirtschaftsinformatik provides the methods and tools to analyze, design, and implement socio-technical systems and makes it therefore suitable for service systems.[60] [61]

Macro level discussion

Following the distinction of Wilde and Hess, Wirtschaftsinformatik can be discussed on two levels: a macro level that is paradigm-oriented and a micro level that is concerned with the variety of methods and tools applied[62]. Paradigms describe shared rules and standards for scientific practice[63] and define which research questions are scientifically recognized and thus examined. The prevalent research paradigm in Wirtschaftsinformatik is design science[64]. The Anglo - American sister discipline is information systems research and recognizes the validity and value of design science as a research paradigm, but is dedicated to the Behavioral Science paradigm[65]. Design science "seeks to extend the boundaries of human and organizational capabilities by creating new and innovative artifacts" and is therefore considered a problem-solving paradigm[66]. Despite the fact that the artifact is a core research object of Wirtschaftsinformatik, there is no unified definition of it[67] [68]. In one of the most used definitions, artifacts are defined as constructs (vocabulary and symbols), models (abstractions and representations), methods (algorithms and practices), and instantiations (i.e., implemented software systems)[69]. With a focus on the creation of innovative artifacts, Wirtschaftsinformatik also can be described as a construction-oriented paradigm, which is focused on the possible future use of IT to solve a problem[70]. Therefore, the research realm of Wirtschaftsinformatik not only includes the design and evaluation of an innovative artifact but the design and evaluation of a possible future world that ideally is improved by the innovative artifact. Putting it differently, the organizational context an artifact resides in changes with the application of the novel artifact, or needs to be changed in order to make the application of the novel artifact possible[71].

Theoretical grounding

In view of the expected developments of ICT in the health care market (see section 1.2), Wirtschaftsinformatik is very suitable to examine the potential impact of the predicted future. Therefore, this thesis subscribes to the construction-oriented

[60] Heinrich, *Wirtschaftsinformatik - Einführung und Grundlegung*, 2001, p. 15-17
[61] Buhl et al., 'Service Science', 2008, p. 64
[62] Wilde and Hess, 'Forschungsmethoden der Wirtschaftsinformatik', 2007, p. 1
[63] Kuhn, *The Structure of Scientific Revolutions*, 1970, p. 11
[64] Österle et al., 'Memorandum on design-oriented information systems research', 2011, p. 2
[65] Peffers et al., 'The Design Science Research Process: A Model for Producing and Presenting Information Systems Research', 2006, p. 85
[66] Hevner et al., 'Design Science in Information Systems Research', 2004, p. 75
[67] Yetim, 'From Communicative Action Theory to Socio-Technical Artifacts: Presentation of Three System Prototypes', 2009, p. 25
[68] Zelewski, 'Kann Wissenschaftstheorie behilflich für die Publikationspraxis sein? Eine kritische Auseinandersetzung mit den "Guidelines" von Hevner et al.', 2007, p. 118
[69] Hevner et al., 'Design Science in Information Systems Research', 2004, p. 77
[70] Frank, 'Towards a pluralistic conception of research methods in information systems research', 2006, p. 5
[71] Frank, 'Die Konstruktion möglicher Welten als Chance und Herausforderung der Wirtschaftsinformatik', 2009, pp. 165-166

approach of Wirtschaftsinformatik and develops different artifacts. Based on the identified requirements, a conceptual framework shall be built for the design of individualized information-intensive services. Feasibility of the developed theoretical artifact shall be demonstrated by a software prototype. The envisaged artifacts show that this thesis follows the research cycle in Wirtschaftsinformatik: the identification of a real-life problem, the design of artifacts to improve (business) reality (in this case the conceptual framework) and the evaluation of the resulting changes (in this case the application of the framework to develop a prototype and its evaluation), which re-starts the research cycle by identifying new problems (in this case identification of open questions)[72] [73].

1.5 Scientific inquiry

Micro level discussion

Based on the chosen paradigm on the macro level, different research methods are preferred on the micro level. Research prototyping and deductive reasoning are common methods applied in Wirtschaftsinformatik, whereas deductive reasoning for the most part is conducted argumentatively[74]. Furthermore, the discussion of rigor and relevance on the macro level, i.e. the need for scientific soundness of research and practical relevance, influences the micro level. Since economic success often was the most important proof of validity of research results, Wirtschaftsinformatik faced the issue of weak scientific rigor. A focus on strong scientific rigor in the Anglo-American sister discipline on the other hand led to the opposite issue: weak practical relevance.[75] As a consequence, a pluralistic use of methods is advocated and examined on the micro level. In this context, the explicit disclosure of the applied research methods is of great importance to ensure transparency, traceability, and comparability of research results.[76] [77]

Discussion of research method

Following this approach, several literature reviews shall be performed in this thesis to form the analysis framework. A literature review will be based on a characterization scheme whose categories will be derived from the identified relevant papers, i.e. ad hoc and not theory-driven[78] [79]. The goals are to develop an understanding of

[72] Fettke and Loos, 'Zur Identifikation von Strukturanalogien in Datenmodellen - Ein Verfahren und seine Anwendung am Beispiel des Y-CIM-Referenzmodells von Scheer', 2005, p. 89

[73] Heinrich, 'Forschungsmethodik einer Integrationsdisziplin: Ein Beitrag zur Geschichte der Wirtschaftsinformatik', 2005, p. 107

[74] Wilde and Hess, 'Forschungsmethoden der Wirtschaftsinformatik', 2007, pp. 283-285

[75] Österle et al., 'Memorandum on design-oriented information systems research', 2011, p. 2

[76] Niehaves, 'Epistemological perspectives on multi-method information systems research Paper 120', 2005, p. 4

[77] Frank, 'Towards a pluralistic conception of research methods in information systems research', 2006, p. 40

[78] Fettke and Loos, 'Entwicklung eines Bezugsrahmens zur Evaluierung von Referenzmodellen - Langfassung eines Beitrages', 2004, p. 4

[79] see page 57 for the applied categories

the current state of research and the integration of different findings[80]. Literature reviews are applied to tackle research question 1 (What are the characteristics of individualization of information-intensive services? What are core design aspects for individualization of information-intensive services?) and research question 2 (What can existing approaches contribute to the design of individualized information-intensive services). The resulting knowledge is reached via inductive reasoning, i.e. generalizations are derived from observing multiple specific instances[81] leading to the requirements for the conceptual framework (see research question 3: What are the requirements for the indivdualization of information-intensive consumer-oriented services? What does a conceptual framework look like?). The conceptual framework is a theoretical artifact and builds the foundation for the creation of a prototype. The prototype as IT artifact serves as a proof of concept of the theoretical artifact, i.e. the conceptual framework. The prototype is furthermore evaluated in a field study in order to prove its relevance. The data collected from the field study shall be analyzed based on qualitative parameters (e.g. from questionnaires) and technical parameters (e.g. from recommender system research), i.e. a hybrid approach is applied (see research question 4: How can the conceptual framework be applied for the individualization of disease prevention and well-being services? How is the resulting prototype implemented and evaluated?). Overall, an analytic-descriptive perspective (in this case category-based evaluation of the state of research and inductive reasoning) for research question 1 and 2 is applied and an empirical (in this case field study and its evaluation) perspective for research question 3 and 4 is applied[82] to ensure rigor as well as relevance.

Research projects

The European research projects **m:Ciudad - A Metropolis of Ubiquitous Services**[83] and **uService - Ubiquitous Service Infrastructure for the Mobile Super Prosumer**[84] that accompanied this work provided valuable insights and content to this thesis. Both projects worked on the development of a new service architecture for user-generated micro-services. Micro-services are small sharply focused mobile applications allowing end users to share personal content[85] [86]. Within the scope of these projects requirements analyses, technical and functional architectures, implementation of semantic search and recommendation engine as well as field studies were conducted and are included and extended in this thesis.

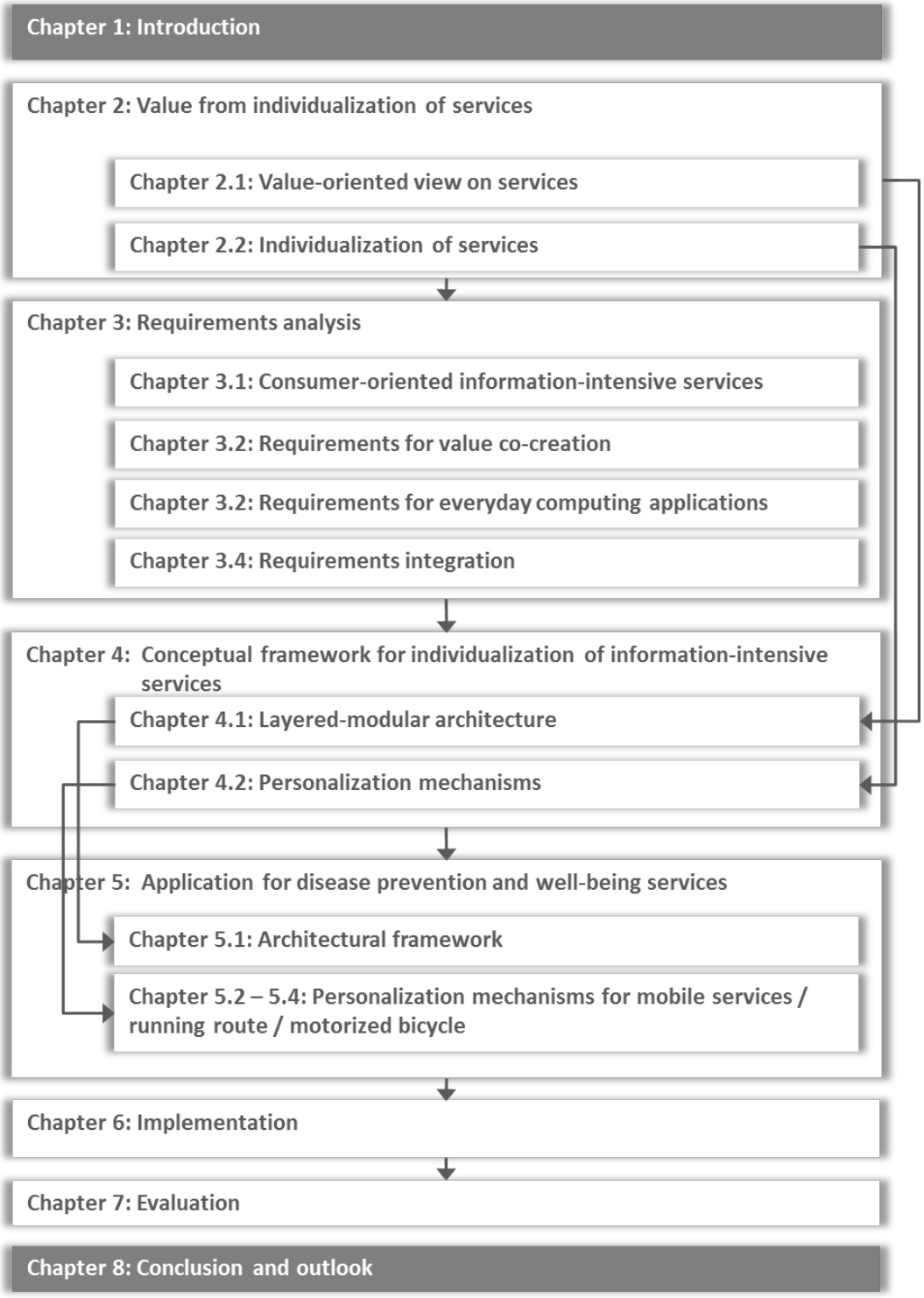

Figure 1.2: *Thesis structure, Source: own representation*

1.6 Structure of the thesis

The thesis consists of eight chapters and is framed by the introduction in chapter 1 and the conclusion in chapter 8 (see figure 1.2). Chapter 2 is concerned with an value-oriented view on services. It analyzes the artifact service from its origins, i.e. from a production-oriented point of view, to a more recent approach, i.e. a consumer-oriented point of view. Furthermore, the value creation potential of individualization of services is delineated and the technical aspects of individualization are derived which builds the bridge to the technological grounding of this thesis in recommender system research. This provides the basis for the following requirements analysis in Chapter 3, where at the beginning the characteristics of consumer-oriented, information-intensive services are explicated and mobile services are identified as instantiations of consumer-oriented, information-intensive services. Requirements for individualization are identified from a value-oriented, i.e. a theoretical, point of view, as well as in terms of everyday computing applications. Everyday computing applications represent an application-oriented point of view on individualization. The chapter concludes with an integration of the derived requirements with the technical aspects of individualization from recommender system research. Chapter 4 describes the conceptual framework, the layered-modular architecture, and matches it with the identified requirements. Considerations from service-dominant logic and individual information systems in Chapter 2 are applied to the design of the layered-modular architecture. Furthermore, it details the mechanisms for personalization by detailing approaches of recommender system research. This is based on the technical aspects of individualization derived in Chapter 2. Chapter 5 demonstrates the feasibility of the framework in chapter 4 by applying it to the development of a prototype for the domain of disease prevention and well-being services. It is structured according to two main layers of the framework: client-side layer and the server-side layer. This means that the main module of the client-side layer, the design of the graphical user interface, and the main module of the server side layer, the design of the personalization mechanism, are described. Chapter 6 details the implementation approach of the prototype MENTORbike which is an instantiation of the architectural framework described in chapter 5. The results of the evaluation of the prototype are presented in Chapter 7. The evaluation is conducted at different degrees of depth and with different goals. Results of an in-depth examination (i.e. technical, performance and usability evaluation) of the implementation of the architectural framework show that the recommendation

[80] Fettke, 'State-of-the-Art des State-of-the-Art - Eine Untersuchung der Forschungsmethode „Review" innerhalb der Wirtschaftsinformatik', 2006, p. 258
[81] Schoder and Putzke, *Erklärungsorientierter Forschungsansatz*, 2013
[82] Fettke and Loos, 'Entwicklung eines Bezugsrahmens zur Evaluierung von Referenzmodellen - Langfassung eines Beitrages', 2004, p. 7
[83] Grant agreement number 215007, in the following abbreviated as m:Ciudad
[84] Project number ITEA 2 ip08001, in the following abbreviated as uService
[85] M:Ciudad, *m:Ciudad - A metropolis of ubiquitous services*, 2010
[86] uService, *uService - Ubiquitous Service Infrastructure for the Mobile Super Prosumer*, 2013

process works. The results of the evaluation of the running and cycling example prove that a demand for such a service exists and that the architectural framework is applicable to the sector of disease prevention and well-being activities. For the running application the practical relevance is examined via a survey of the target group. For the cycling example a field test is conducted in a rehabilitation scenario, where requirements for safe cycling outdoor training are much higher. Therefore, the results are feasible for a less strict scenario of disease prevention and well-being applications for personalization mechanisms during cycling.

2

Value from individualization of services

The first section dives into services and introduces with the service-dominant logic a value-oriented view on services. The second part deals with individualization of services. Based on the value-oriented view on services information systems are introduced which enable value co-creation between a consumer and a provider of a service. Then two approaches for service individualization are described: mass customization and personalization. Assistance services from mass customization and personalized services experience from personalization are identified as approaches which provide value co-creation via individualization.[87] Aspects of these two approaches are extended with technological aspects of individualization from recommender systems research. The result of this chapter is a theory-oriented framework for the requirement analysis in the next chapter.

2.1 Value-oriented view on services

This section starts with a description of the origins of service research. It continues to described the shift of focus from a production-oriented view to a value-oriented view on services. The traditional definitions of a service are delineated in the next section. Services are then described with the more recent considerations from service-dominant logic which focuses on value co-creation which assigns the consumer of a service a more important role than in the traditional point of view.

2.1.1 Origins of service research

Beneficiary of a service

Research on services dates back to the 1960s and originated in marketing research[88]. A marketing-oriented perspective is still prevalent in the Anglo-American scientific

[87] Mass Customization and Personalization are not clearly distinguishable. Therefore descriptions might overlap and seemingly repeat themselves.

[88] Lovelock and Gummesson, 'Whither Services Marketing?: In Search of a New Paradigm and Fresh Perspectives', 2004, p. 22

community. A main characteristic is the focus on communication and its improvement. Internal communication within a company as well as external communication with the customer/consumer are common research objects. Approaches from 1:1 marketing (see section 1.1) to gather information about wishes and needs of individual customers/consumers are an example of research on the improvement of external communication.[89] A **customer** is the individual or entity who determines whether or not the service provider shall be compensated for production[90]. Either an individual or a group may decide if a service provider is compensated. For instance, in case of medical care services, the patient and the insurance company are involved in the decision-making process.[91] A **consumer** is the ultimate user of a service or the beneficiary of a service. The consumer is not necessarily the customer at the same time, i.e. the individual making the purchase decision. For instance, a child does not decide which medical care service is performed, but the parents. Therefore, the child is the consumer or beneficiary of the medical care service and the parents are the customers.[92] This thesis is focused on the beneficiary of a service and the value a service provides to the beneficiary. Therefore, the term consumer is used throughout the text.[93]

Service engineering and service science

Service development is examined in service engineering and service science. Service engineering, which originated in the 1980s in Germany, takes a production-oriented point of view on services.[94] It follows a construction-oriented approach which is grounded in engineering.[95] "Service engineering applies the modified engineering know-how established in the field of conventional product development to the development of services."[96] Another influence on service engineering is Wirtschaftsinformatik, since ICT enabled improved and structured development processes for services. Furthermore, new types of services, e.g. electronic services which are services provided over electronic networks[97], were made possible and analyzed with the methods and tools of Wirtschaftsinformatik.[98] Therefore, similarities of the developments in Wirtschaftsinformatik and service engineering are not coincidental, since prominent scholars of Wirtschaftsinformatik co-developed and influenced service engineering.

[89] Meyer and Böttcher, *Entwicklungspfad Service Engineering 2.0 - Neue Perspektiven für die Dienstleistungsentwicklung*, 2012, p. 10
[90] American Marketing Association, *AMA Dictionary: Customer Definition*
[91] Sampson and Froehle, 'Foundations and Implications of a Proposed Unified Services Theory', 2006, pp. 332-333
[92] American Marketing Association, *AMA Dictionary: Customer Definition*
[93] Exceptions are due to direct quotes which use the term customer.
[94] Karwowski, Salvendy and Ahram, 'Customer-Centered Design of Service Organizations', 2009, p. 179
[95] Meyer and Böttcher, *Entwicklungspfad Service Engineering 2.0 - Neue Perspektiven für die Dienstleistungsentwicklung*, 2012, p. 10
[96] Karwowski, Salvendy and Ahram, 'Customer-Centered Design of Service Organizations', 2009, p. 180
[97] RT Rust and Kannan, 'E-service: a new paradigm for business in the electronic environment', 2003, p. 38
[98] Leimeister, *Dienstleistungsengineering und -management*, 2012, p. 101