THE APPLICATION OF CHATBOTS AT THE DIGITAL WORKPLACE IN BUSINESSES

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EMPIRICAL INSIGHTS AND DESIGN RECOMMENDATIONS FOR BUSINESS CHATBOTS

DOCTORAL THESIS

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Preface

This doctoral thesis addresses the adoption of chatbots at the digital workplace in businesses by examining the topic with a strong practice-oriented focus. Application scenarios and use cases as well as corresponding objectives, influencing factors and challenges are surveyed. From the design-oriented perspective, it is shown how chatbots should be designed and which impacts can be expected. The thesis is finished with the suggestion of a procedure model for chatbot projects in businesses. The idea for this doctoral thesis originated during my employment as a research assistant at the *Chair of Application Systems and E-Business* at the *Georg-August-Universität Göttingen*. I would like to take this opportunity to thank all those who have supported me during this time, both professionally and privately.

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Göttingen, June 2022 Raphael Meyer von Wolff

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List of Abbreviations

A..... Applicability

A_i ..... Application Area *i*

AI..... Artificial Intelligence

AIML..... Artificial Intelligence Markup Language

AIS THCI ..... AIS Transactions on Human-Computer Interaction

AIS ..... Association for Information Systems

AMCIS..... Americas Conference on Information System

API ..... Application Programming Interface

BI..... Behavioral Intention to Use

CASA..... Computers Are Social Actors

CF*i*..... Central Finding *i*

CRM ..... Customer Relationship Management

CS ..... Customer Support

CSS3..... Cascading Style Sheets Version 3

CW ..... Collaborative Work

$C_{Xi.j.}$ ..... Challenge *j* of Influencing Factor *i* of Category X

D ..... Dependability

DP*i* ..... Design Principle *i*

DSR..... Design Science Research

E..... Efficiency

ERP..... Enterprise Resource Planning

ET..... Education and Training

E_{XPi} ..... Expert *i*

FAQ..... Frequently Ask Question

F_{Xi}..... Influencing Factor *i* of Category X

GDPR..... General Data Protection Regulation

GUI..... Graphical User Interface

HCI ..... Human-Computer Interaction

HICSS ..... Hawaii International Conference on System Sciences

HMD ..... Handbuch der maschinellen Datenverarbeitung / HMD Praxis der Wirtschaftsinformatik

HTML..... Hypertext Markup Language

IA..... Information Acquisition

INT*i*..... Interview *i*

IPO..... Input-Process-Output

IQ ..... Information Quality

IS..... Information System

ISSM ..... Information System Success Model

IT..... Information Technology

JS..... JavaScript

L*i* ..... Limitation *i*

MRQ*i* ..... Meta Research Question *i*

MRQ*i.j* ..... Sub-Meta Research Question *j* of Meta Research Question *i*

N ..... Novelty

NLG..... Natural Language Generation

NLP ..... Natural Language Processing

NLU..... Natural Language Understanding

O*i* ..... Objective *i* of Study I

O_i..... Objective *i* of Study II

OQ*i*..... Open Question *i*

P..... Perspicuity

PAJAIS..... Pacific Asia Journal of the Association for Information Systems

PEoU..... Perceived Ease of Use

PHP..... PHP: Hypertext Preprocessor

P_i ..... Process Characteristic *i*

P_{i_j} ..... Potential *i* with Sub-Potential *j*

PU ..... Perceived Usefulness

Q&A..... Question & Answering

R_i..... Requirement *i* of the Literature

RQ_{ij} ..... Research Question *j* of Study *i*

S..... Stimulation

SP*i*..... Scenario Process *i*

SQ..... Service Quality

SQL..... Structured Query Language

SS ..... Self-Service

TAM..... Technology Acceptance Model

TOE..... Technology-Organizational-Environmental

TOIE..... Technology-Organizational-Individual-Environmental

TTS ..... Text-to-Speech

UEQ ..... User Experience Questionnaire

U_i ..... Usage *i*

UI ..... User Interface

US ..... User Satisfaction

US_i ..... User Story *i*

UTAUT ..... Unified Theory of Acceptance and Use of Technology

VPN ..... Virtual Private Network

WF ..... Without Focus

WI ..... Internationale Tagung Wirtschaftsinformatik

WLAN ..... Wireless Local Area Network

1 Introduction

The present cumulative thesis examines the application of chatbots at digital workplaces in business contexts to support the employees in their daily work under the influence of the ongoing digitalization. The first chapter introduces the research conducted.

Section 1.1 outlines the motivation for the research by describing the current influence of digitalization on daily business work and pointing out how chatbots can be used to tackle existing and emerging problems. The derivable research gaps and the relevance of the research thesis are also presented.

Section 1.2 explains the research aim. In doing so, research questions were derived that guide the three research complexes of the thesis. Furthermore, the intended contributions of the thesis to science and practice are briefly outlined.

Section 1.3 details the positioning of the thesis and the applied research design. The positioning is described both from the thematic perspective, based on the research domains investigated, and from the scientific perspective. For the latter, the scientific methods and theories used and their interplay are pointed out.

Section 1.4 presents the overarching structure of the thesis. The content of each chapter is briefly described, and a short overview of the seven research studies used for this cumulative thesis is given.

1.1 Motivation

"*The design of workplaces has always been in the focus of operational practice and science.*"
(Günther 2017, p. 861)

Concerning this, in recent years, the use of new information technologies and application systems as a result of the progressive digitalization of the economy in general has strongly influenced enterprises and the way employees work. In taking advantage of the new opportunities, many tasks have become automated, thus supporting and relieving employees in their daily work and resulting in improved work practices and work quality. The application of innovative digital technologies is thus shaping the future digital office workplace increasingly digital (Byström et al. 2017; Klaffke 2016; Köffer 2015; Köffer/Urbach 2016; White 2012). Existing established paper-based ways of working are changing or disappearing, and new forms of digital collaboration or office and working structures are emerging, which affects almost every employee in all areas of a company. White-collar workers in particular are affected in the digital business workplace. In fact, employees almost demand the workplace use of new innovative digital technologies, which they know from private use, to enhance the quality of the work environment and the work itself (Byström et al. 2017; Klaffke 2016; Klaffke/Reinheimer 2016; Köffer 2015; Köffer/Urbach 2016; Lestarini et al. 2015; Urbach/Ahlemann 2016; White 2012). In addition, a second "megatrend" should be considered, which is the distribution of messaging services in companies for task completion, communication, or collaboration among employees in day-to-day business (Gentsch 2018; Klopfenstein et al. 2017). The resulting way of working – increasingly independent of location and terminal devices – is playing a key role in shaping the new digital office workplace. This involves using the same application system and information to perform work, regardless of the location, e.g., in the office, on the road, or from home (Byström et al. 2017; Günther 2017). Due to the COVID-19 pandemic, there are indications that this trend will continue in the future, so that video meetings, collaboration tools, and messaging services will become even more relevant for companies in the future (Umbs 2020). However, on the downside of using more and more innovative and smart digital technologies for daily work tasks, the acquisition of information and the execution of tasks in specific, and daily work in general is becoming obstructed. Due to the increasing number of channels and application systems, as well as the information and data sources they require, the danger of information or application overload arises for employees. Instead of improving daily work and supporting employees in a targeted manner, the situation leads to a cumbersome effort to search for, edit, use, and share information, which negatively affects employees' productivity (Carayannopoulos 2018; Lebeuf et al. 2017; Russell 2012; White 2012). In addition, the demand for low-threshold access to systems and ease of use is increasing due to continuous development and the consistent user-centric design of available devices and applications. From the employee perspective, this means that not only must employees be able to handle the variety of systems, which often involves training, but that the use of the correct systems must be decided individually depending on the respective goal or task. This means that media competence is becoming increasingly important (Günther 2017; Köffer/Urbach 2016).

To address the problems and changing requirements of the digitalization of work, modern individual user-centered application systems tailored to tasks are needed to support employees in their work in a targeted manner or to provide digital assistance (Botthof 2015; Klaffke/Reinheimer 2016; Richter et al. 2018; Senderek/Geisler 2015; Urbach/Ahlemann 2016). In general, technological advances, particularly in machine learning and natural language processing, have an impact on these new ways of working and the individual support of employees (Davenport/Kirby 2016; Diederich et al. 2020). Specifically, recent studies have suggested that user-centric information systems (IS) should be provided to support employees individually and in a targeted manner. In addition, GARTNER (2017) forecasts personal assistants as an emerging technology that will be used by the majority of workers within five to ten years. Therefore, they should leverage the increasingly available messaging services, thus facilitating day-to-day business operations. In particular, chatbots or conversational systems as new and intuitive forms of human-computer interfaces have become the focus for future workplace design to support employees in their daily work (Følstad/Brandtzæg 2017; Reshmi/Balakrishnan 2016). Even though the technology has existed for a long time, e.g., the first instantiations were developed in the 1960s (Weizenbaum 1966) and 1990s (Wallace 2009), current technological advances in artificial intelligence (AI), natural language processing (NLP), and computing resources are giving it a new rise (Dale 2016; Stucki et al. 2018). It has been shown that chatbots are a promising information system because users can control them or the (enterprise) systems behind them without prior training due to their intuitive, natural, and human-like capabilities. Instead of learning extensive and complex user interfaces, users should ideally be able to write or speak their needs based on dialog and independent of specific phrases. Consequently, the chatbot adapts itself to the user's needs and executes the corresponding business functions, provides the desired information, or assists the user in another way (Aquino 2012; Carayannopoulos 2018; Følstad/Brandtzæg 2017; Reshmi/Balakrishnan 2016; Schäffner 2017; Schonschek 2017). Therefore, chatbots are integrated into existing communication channels and/or interfaces and into existing application systems of the business system landscape via interfaces instead of introducing an additional application for users (Klopfenstein et al. 2017). Chatbots should therefore reduce service costs and handle multiple user inquiries at the same time, 24 hours a day, and independent of the availability of human resources (Ranoliya et al. 2017). Process automation is provided as chatbots are answering questions on their own, especially in customer support scenarios (Gnewuch et al. 2017), so that overall systems become more user-centered and the quality of work improves. Notably, the human-like and natural design should contribute to a positive user perception and service experience and create the feeling of personal contact despite interacting with an application system (Diederich et al. 2019a).

Although science and practitioners assume that chatbots can influence employees' productivity positively, the technology itself is still in the early stages of development. Even though dialog-based systems (e.g., Amazon's Alexa or Ikea's Anna) are popular among consumers, chatbots are currently not commonly used in enterprises for workplace support, and corresponding application areas are lacking (Bott 2017; Korenziowski 2017). Particularly, in customer-oriented areas, such as customer service, sales, or financial advising, chatbots have already demonstrated that they can produce positive effects, which is an indication of the presumed potential to support employees in their daily work or the collaboration between employees (Gnewuch et al. 2017; Strehlitz 2017; Stucki et al. 2018). However,

besides the currently common application of chatbots in customer service or employee support scenarios, the scientific knowledge base is still limited in terms of the application of chatbots for daily work tasks (e.g., business processes and transactions), day-to-day organization, or supporting employees. Existing studies focus mostly on the application area of information acquisition (e.g., Carayannopoulos 2018; Reshmi/Balakrishnan 2016) or general design aspects such as anthropomorphism, gender, or response behavior (e.g., Diederich et al. 2020; Feine et al. 2019a; Go/Sundar 2019). Additionally, the studies often only focus on particular use cases and design corresponding chatbots without detailing underlying requirements. However, this current research is related neither to the professional workplace (and would have to be transferred) nor to the enterprise or business domain. Consequently, the advantages of using chatbots in an enterprise context have received little attention in academic research to date and remain an area of interest, although chatbots or conversational agents are already considered by scientific research for diverse areas of research. Thus, an overarching and accepted role of chatbots at the digital office workplace in business contexts is also missing (Zamora 2017a). Herein lies the research gap: the application of chatbots at the digital workplace in businesses to support employees in their daily work. This is problematic for three reasons. First, the already recognized potentials of chatbots cannot be transferred to process applications as they occur in the workplace nowadays. Therefore, chatbot research remains isolated and difficult to apply in a generalized way by businesses. Second, the current chatbot research does not reflect actual daily working situations. Consequently, the integration of chatbots in the workplace and the utilization of previous findings are further hindered, as companies can only assume what the impact will be. Third, the success of chatbot projects largely depends on the users. As users only work with natural language user interfaces, these must, without exception, also be suitable for business applications, which also has an impact on the application possibilities and the corresponding chatbot design. Therefore, the application of chatbots to support employees during their daily work at the digital business workplace is the focus of this cumulative doctoral thesis. The resulting research objectives formulated using the research questions are presented in the following section.

1.2 Research Aim

Based on the present situation in business driven by the ongoing digitalization, the overarching goal of this cumulative thesis is to address the support and assistance of employees during their work influenced by the digital transformation. In specific, the research aim is to holistically investigate the application and utilization of chatbots to support employees at the digital business workplace from an enterprise perspective. Accordingly, it is necessary to investigate both application possibilities and the general framework to provide design principles and recommendations for successful chatbot adoption. Thus, the aim of the thesis is furthermore to create a basis for chatbot development in digital workplace contexts. The work is intended to have high practical relevance by considering actual company processes and specifics as the starting basis and by outlining the results in such a way that they can be used by companies without neglecting the scientific-methodical foundation. Therefore, based on this research aim, three research complexes are successively addressed to ensure the holistic investigation of the problem domain. For each research complex, meta research questions (MRQ*i*) are formulated.

According to the individual research studies conducted in the three research complexes, the meta research questions are refined in Section 3 to address each respective research contribution before answering them in Section 4 based on the thesis findings.

In order to provide a solid foundation for the whole thesis, it is necessary to survey the current scientific knowledge base and current practice situation on chatbot applications for digital workplaces. Therefore, in research complex A the state of art and practice is analyzed in order to identify starting points for chatbot development at the digital workplace and to confirm the research relevance of the overarching research project [MRQ1]. For this purpose, the state of the art must be analyzed to systematize the research area and to determine open research questions or gaps [MRQ1.1]. Accordingly, it is necessary to identify viable application areas on which the design studies of research complex B can build [MRQ1.2]. Furthermore, it should be investigated which objectives are pursued to justify the application and to be able to take these into account in the design recommendations [MRQ1.3]. Lastly, the factors influencing a chatbot operation and the associated challenges must be considered so that they can be taken into account, especially in practical operations [MRQ1.4]. Based on these four sub-meta research questions, a holistic and scientifically grounded starting basis for research complexes B and C can be created. Consequently, in Study I a structured literature review is conducted (Meyer von Wolff et al. 2019a). Grounding on this knowledge, both the scientific literature and a qualitative expert interview study are used to determine viable application areas and the objectives of chatbot applications in Study I (Meyer von Wolff et al. 2019a) and Study II (Meyer von Wolff et al. 2020a). Study III examines the influencing factors and challenges for chatbots at digital workplaces (Meyer von Wolff et al. 2021b). Therefore, the following research questions guide research complex A and the respective three research studies (see Table 1).

Research Complex A: State of the Art and Practice on Chatbots at Digital Workplaces	
MRQ1	How do science and practice contribute to the application of chatbots at the digital workplace?
MRQ1.1	What is the state of the art on chatbots for digital workplaces?
MRQ1.2	Which application areas are viable for chatbots at digital workplaces?
MRQ1.3	Which objectives are associated with a chatbot application at digital workplaces?
MRQ1.4	Which constraints exist for the application of chatbots at digital workplaces?

Table 1 Research Questions of Research Complex A

Based on research complex A, research complex B addresses actual applications of chatbots at the digital workplace. Therefore, the overarching meta research questions focus on the design of chatbots in business contexts [MRQ2]. To provide design recommendations and principles, it is necessary as a first step to derive design requirements for chatbots at the digital workplace [MRQ2.1]. Based on these requirements, respective chatbots can be developed and implemented. Furthermore, the application must be evaluated from two perspectives. First, as chatbots should assist and support employees, it is important to include users' perspectives to measure their acceptance and meet their expectations [MRQ2.2]. Second, as economic factors in particular play a role for companies, the business value of chatbots must be considered [MRQ2.3]. Lastly, for the results to be usable in future studies or independently of a respective company or business task, it is necessary to generalize them [MRQ2.4].

Consequently, to address research complex B, Study IV provides technical and content-related requirements for chatbots (Meyer von Wolff et al. 2020b). Study V builds upon them and, in particular, analyzes the users' perspective for IT-support chatbots (Meyer von Wolff et al. 2020d). The study also serves as a pre-test of certain design decisions of Study VI. Study VI combines the individual research, by designing a process-based chatbot for a business process at the digital workplace, evaluating it from the perspective of both users and business, and documenting the knowledge in a generalized nascent design theory (Meyer von Wolff et al. Forthcoming). Therefore, the following research questions guide research complex B and the respective three research studies (see Table 2).

Research Complex B: Design of Chatbot Applications for the Digital Workplace	
MRQ2	How should chatbots in the business context be designed?
MRQ2.1	Which design requirements exist for chatbots at digital workplaces?
MRQ2.2	How do users assess the application of chatbots at digital workplaces?
MRQ2.3	What is the business value of chatbots at digital workplaces?
MRQ2.4	How to generalize the design knowledge?

Table 2 Research Questions of Research Complex B

Lastly, research complex C addresses the problem of missing practice-focused and enterprise-applicable guidelines for chatbot introduction and operation. In particular, the support of practice in chatbot projects is the basis of this research area [MRQ3]. On one hand, it is important to examine how current existing scientific findings can be used in a targeted manner for chatbot projects in businesses, as this research is often divided due to the individual research contributions in the scientific knowledge base [MRQ3.1]. On the other hand, support should be provided in the form of recommended actions or project structure plans to provide applicable recommendations for chatbot deployment in companies that cover the entire life cycle of the chatbot [MRQ3.2]. Consequently, in Study VII an applicable project structure plan in the form of a procedure model for chatbot projects based on the knowledge of Studies I-VI and the scientific knowledge base is designed (Meyer von Wolff et al. 2022a). Therefore, the research questions in Table 3 guide research complex C.

Research Complex C: Chatbot Development, Introduction, and Operation in Business	
MRQ3	How can practice be supported purposefully in chatbot projects?
MRQ3.1	How can scientific results be used to guide chatbot projects in businesses?
MRQ3.2	How should practice-oriented chatbot projects in businesses be structured?

Table 3 Research Questions of Research Complex C

Hence, the entire research project documented in this thesis aims at providing several contributions to science and practice based on three research complexes and the research questions they answer. Thus, grounded on both explanatory-based and design-oriented research studies, the thesis makes the following contributions (see Table 4).

Contribution to Science	Contribution to Practice
§ **Systematization** of the **research field** [*MRQ1.1]* § Identify scientifically- and empirically-founded **application areas** for chatbots at the digital workplace [*MRQ1.2*] § Determine scientifically- and empirically-founded **objectives** for chatbot applications at the digital workplace [*MRQ1.3*] § Determine empirically-founded **influencing factors** and **challenges** of chatbot applications at the digital workplace [*MRQ1.4*] § Identify application-related, domain-specific, and (information) technical **requirements**, **prerequisites**, and **framework conditions** for chatbots at the digital workplace [*MRQ2.1*] § Demonstrate **evaluation approaches** for chatbots from the perspective of both users and business [*MRQ2.2-3*] § Establish scientific **design recommendations** and **design principles** for chatbots at the digital workplace [*MRQ2.4*] § Derive a **guideline for practical use** to make scientific results on chatbots for digital workplaces operational by businesses [*MRQ3.1-2*]. § Survey the **application of chatbots** at digital workplaces **scientifically** and **holistically** while addressing the **organizational perspective** [*MRQ1-3*] § Derive **further research questions** and **starting points** for **future research** [*MRQ1-3*]	§ Show **current concepts** and **implementations** of chatbots for the digital workplace [*MRQ1.1*] § Identify scientifically- and empirically-founded **application areas** for chatbots at the digital workplace [*MRQ1.2*] § Determine scientifically- and empirically-founded **objectives** for chatbot applications at the digital workplace [*MRQ1.3*] § Determine empirically-founded **influencing factors** and **challenges** of chatbot applications at the digital workplace [*MRQ1.4*] § Point out **design recommendations** and **design principles** for chatbots at the digital workplace [*MRQ2.4*] § Identify **benefits** and **limitations** of chatbots at the digital workplace from the perspective of both users and business [*MRQ2.2-3*] § Construct a **chatbot procedure model** to guide businesses in chatbot projects during the whole chatbots' lifecycle [*MRQ3.1-2*] § Examine the **application of chatbots** at digital workplaces **scientifically** and **holistically** while preparing the results in a **way that is applicable in practice** [*MRQ1-3*]

Table 4 Thesis' Contributions to Science and Practice

1.3 Positioning of the Thesis and Applied Research Design

As outlined in the motivation section, driven by the ongoing digitalization of work and businesses and the resulting implications and challenges, the overall thesis addresses the intersection between the research domains of digital assistance systems and the corporate context during digitalization (Klaffke/Reinheimer 2016; Richter et al. 2018). Thus, the research is positioned in the design-oriented business information systems domain with a clear practice focus (Österle et al. 2010). In specific, the thesis addresses the application of chatbots at digital workplaces.

From the economic perspective, the research thesis deals with the changes in daily work due to ongoing digitalization and addresses the resulting problems, particularly related to employees. The requirements of businesses and their processes should thereby be addressed by innovative IT-artifacts. From the technical perspective, chatbots have emerged as a new user-centric application system enabling intuitive use via a natural dialog. Hence, chatbots' possibilities in the corporate application are to be investigated. Furthermore, chatbot research is a strong interdisciplinary research topic that concerns not only economic, technical, and design science. Especially, human-computer interaction (HCI) research is becoming increasingly important to include the user perspective (Følstad/Brandtzæg 2017). Only when users are pleased, chatbots will be used and be able to support the employees. Therefore, human-computer interaction will also be considered. Thus, the research thesis consequently addresses solving the emerging problems of digitalization at the digital workplace via the application of chatbots. The thesis surveys the application of chatbots as a business information system to address the business problem of supporting employees in their daily work. It is examined which application areas are viable,

which influencing factors and challenges are to be considered, how respective chatbots should be designed, and how chatbot projects should ideally be carried out. To sum up, the thematic position of the thesis is outlined in Figure 1.

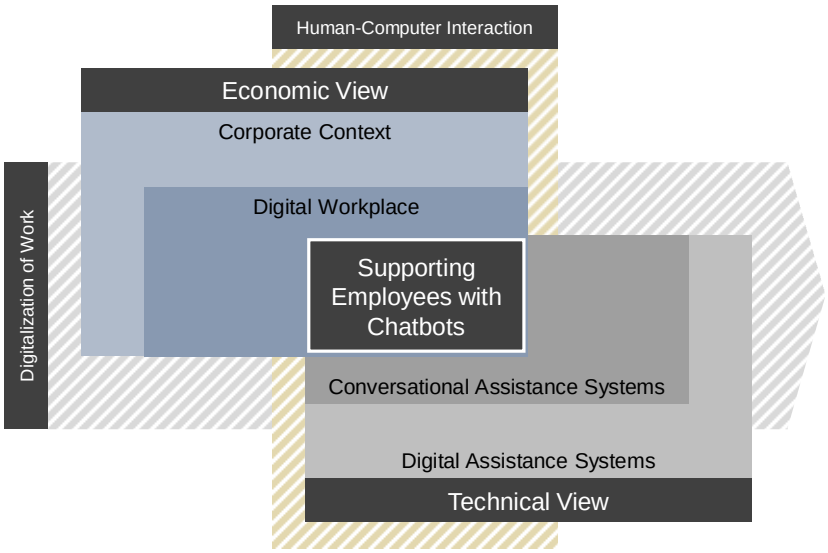

Figure 1 Thematic Positioning of the Thesis

Furthermore, the thesis aims at a high practical relevance by highlighting the use of chatbots from a business perspective but without neglecting the scientific contributions. The thesis is therefore positioned in the design-oriented business information systems domain (Österle et al. 2010), and for that reason, both explanation-oriented and design-oriented research methods are applied. The explanatory part includes the scientifically founded survey of a chatbot application in order to create the basis for the design part and to determine the outcomes. The design part of this thesis aims at identifying requirements for chatbots in the business context to develop respective systems. In addition, the design of process guidelines for chatbot projects should be followed. The acquired knowledge is used to derive generalizable design recommendations. Thus, the research questions are partly investigated using multiple research studies with different research methods and perspectives. Due to this interplay of different research paradigms and methods, this work is in accordance with the desired methodological pluralism of business informatics (Österle et al. 2010; Wilde/Hess 2007). The thesis is therefore also positioned in both research streams human-computer system design and IS organization and strategy (Banker/Kauffman 2004). First, the thesis aims at providing viable chatbots for users, taking into account their requirements and desires. Second, the thesis aims at surveying viable application scenarios for organizations and assessing the impacts of chatbots on organizations.

To achieve the research aim of the thesis, in research complex A the explanatory paradigm and the scientifically-founded basis for the upcoming studies are laid. Therefore, a structured literature review according to COOPER (1988), FETTKE (2006), and WEBSTER/WATSON (2002) is conducted (Study I). Based on accessible scientific and practice-relevant databases, 52 relevant scientific articles are identified that are in accordance with two relevance criteria (Vom Brocke et al. 2015). In doing so, the state of the art is shown, and application areas and objectives are outlined [MRQ1.1-3]. Consequently, the research relevance is outlined by highlighting research gaps and deriving open research questions. On this basis and to include the current practice situation and maintain the practical relevance, a

qualitative empirical cross-section interview study with 29 experts in chatbot applications at the digital workplace is conducted according to DÖRING/BORTZ (2016), MYERS (2013), and WILDE/HESS (2007). As no scientific or practice systematization of the research topic exists, a grounded theory-based approach is also taken to identify application areas and objectives [MRQ1.2-3] (Study II), as well as influencing factors and challenges [MRQ1.4] (Study III) (Glaser/Strauss 2006; Wiesche et al. 2017). For this, the *Devil's Quadrangle* model of SNEED/MEREY (1985) was applied to categorize the objectives. In addition, the influencing factors and challenges are classified using the T*echnology-Organizational-Individual-Environmental* framework of ROSLI ET AL. (2012) or AWA ET AL. (2017), which is an extension of the well-established *Technology-Organizational-Environmental* framework (DePietro et al. 1990).

Taking into account the explanatory empirical results, research complex B addresses the design of chatbots for digital workplaces. First, grounded on the research gaps of the literature review, a quantitative study is conducted (Study IV) (Wilde/Hess 2007). For this purpose, 166 participants were questioned via an online questionnaire consisting of closed and open questions to determine their technical and content-related requirements for information acquisition chatbots [MRQ2.1]. Second, a case study for the IT-support is performed (Study V). Therefore, a chatbot is designed that is capable of handling three typical IT-support scenarios that differ in the structure, the scope of functions, and the visualization offered [MRQ2.1]. In the evaluation, 93 participants used the chatbot in all three scenarios for three evaluation tasks. A questionnaire with open and closed questions is used to measure the users' perspective [MRQ2.2], particularly taking into account items of the established *User Experience Questionnaire* (Laugwitz et al. 2008). The evaluation of the chatbot is also used as a preliminary test for the subsequent most comprehensive Study VI. In this study, a *Design Science Research* (DSR) approach to design a process-based chatbot for the digital workplace is employed, and a complete DSR iteration according to HEVNER ET AL. (2004), and HEVNER (2007) was carried out (Study VI). Furthermore, the study follows the recommended publication pattern of GREGOR/HEVNER (2013). Additionally, the requirements for the process-based chatbot are derived based on users' expertise, a process analysis, and the current scientific literature on designing enterprise chatbots. According to the formalization of GREGOR ET AL. (2020), generalized design principles are derived and outlined [MRQ2.1]. Based on the design principles, a DSR chatbot artifact (product artifact) is implemented that is used for the evaluation (Baskerville/Pries-Heje 2010; Hevner et al. 2004). The evaluation consists of a laboratory experiment with 69 participants from three groups (students, employees, (external) experts). The users' perspective [MRQ2.2] and the business value [MRQ2.3] were the subjects of the evaluation. In the evaluation, a questionnaire was filled out and qualitative interviews with the experts were conducted (Wilde/Hess 2007). The questionnaire was built around the concepts of IT-affinity (Franke et al. 2019), user experience (Laugwitz et al. 2008), and acceptance. For the acceptance evaluation, the established *Technology Acceptance Model* (Davis 1993) and the *Information System Success Model* (DeLone/McLean 2003) were used to identify usable items. In addition to the questionnaire, process efficiency and quality measures were calculated to identify the business value. Lastly, the acquired design knowledge was transferred into a nascent design theory on "*Design & Action*" [MRQ2.4], as proposed by GREGOR/JONES (2007). Notably, as the studies in research complex B aim at providing viable chatbots for a useful application area or respective task at the digital workplace, these studies

can also be considered in the context of the *Task-Technology Fit Theory* (Goodhue/Thompson 1995) or the *Fit-Viability Theory* (Liang et al. 2007). As Study V and Study VI in particular analyze a business task, apply a respective chatbot, and measure its outcomes and benefits, they in a sense indicate the fit or the performance of chatbots for the respective business task. However, as these two studies each had a different research objective, this was not explicitly addressed and can only be inferred indirectly.

Lastly, research complex C addresses the design of a guideline for developing and introducing chatbots in business contexts. In order to provide applicable knowledge for practice, it was surveyed, how scientific findings can be used for chatbot projects [MRQ3.1]. Therefore, a *Design Science Research* study with two completed iterations was conducted (Hevner et al. 2004; Hevner 2007). Based on the acquired knowledge and the conducted research studies, a prototype process artifact for a procedure model was designed (Baskerville/Pries-Heje 2010; Hevner et al. 2004) using process modeling techniques. According to two evaluations, based on which the model was adjusted, a final procedure model for the whole chatbot lifecycle was derived [MRQ3.2]. Both evaluations were conducted as workshops where annotations were taken; the first workshop included 10 local participants in individual appointments, and the second workshop included 13 participants at an international conference.

To summarize, Table 5 outlines the described scientific positioning of the thesis and the interplay of the different research methods and theories applied with regard to the research questions.

MRQ			Paradigm	Research Method	Theories and Models
Complex A	1	1	Explanatory	Structured Literature Review Qualitative Empirical Cross-Section Interview Study	–
		2	Explanatory		Grounded Theory
		3	Explanatory		Grounded Theory Devils Quadrangle
		4	Explanatory		Grounded Theory Technology-Organizational-Individual-Environmental Framework
Complex B	2	1	Explanatory Designing	Quantitative Questionnaire Study Case Study Design Science Research (*Product Artifact*): § Literature Review § Deductive Reasoning § Prototyping Product-Artifact § Laboratory Experiment § Case Study § Quantitative Questionnaire § Qualitative Interviews Argumentative Reasoning	–
		2	Designing		Technology Acceptance Model Information Systems Success Model
		3	Designing		Technology Acceptance Model Information Systems Success Model
		4	Explanatory Designing		Nascent Design Theory
Complex C	3	1	Designing	Design Science Research (*Process Artifact*): § Deductive Reasoning § Prototyping Process-Artifact § Process Modeling § Qualitative Workshop Argumentative Reasoning	–
		2	Designing		–

Table 5 Scientific Positioning of the Thesis

1.4 Structure of the Thesis and Overview of Research Studies

This section provides an overview of the thesis' structure. The thesis consists of four parts: introduction, foundations, conducted research studies, and conclusion (see Figure 2).

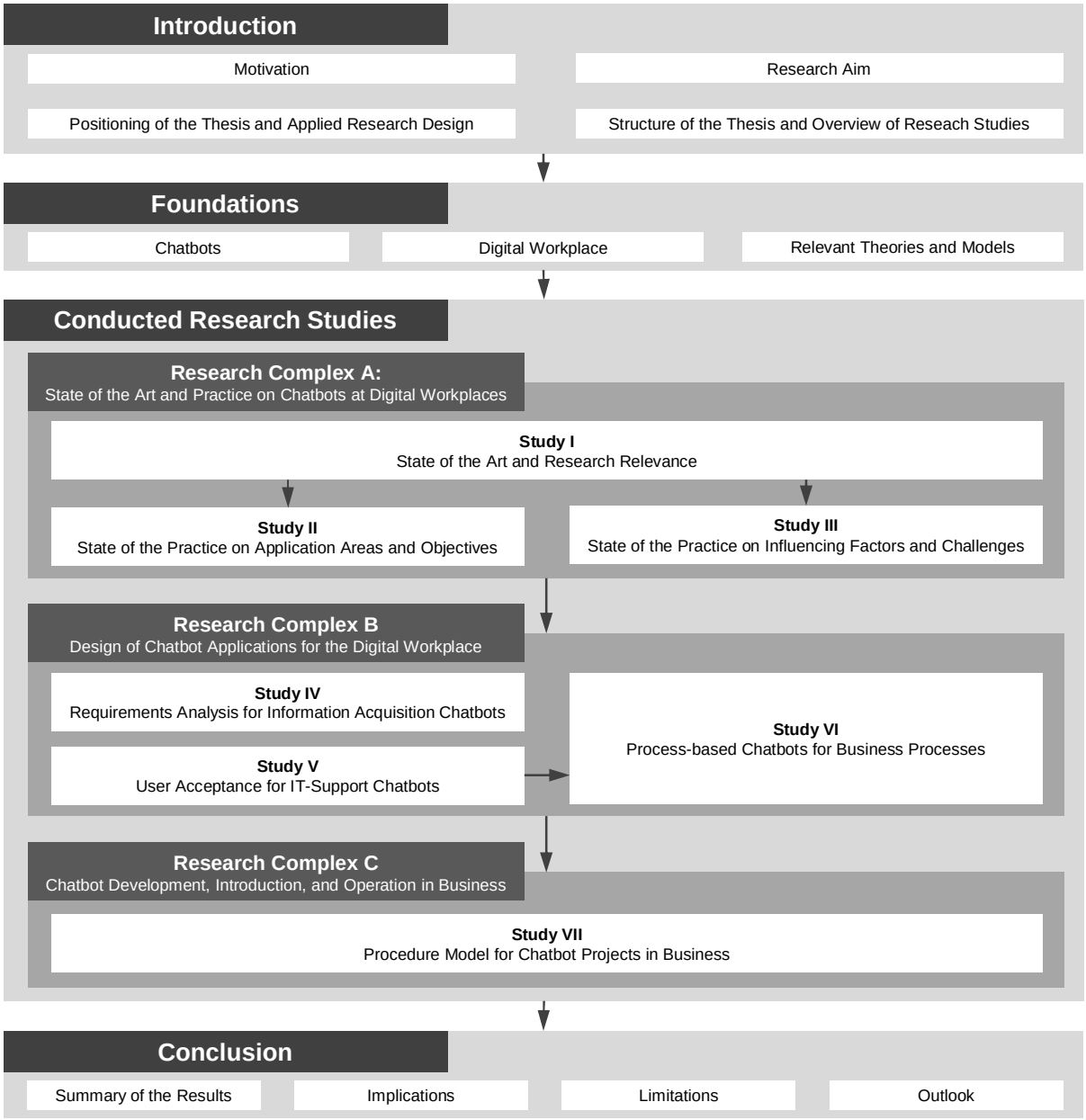

Figure 2 Structure of the Thesis

In the **introduction**, the motivation for the thesis, the grounding problem (see Section 1.1), and the research aim (see Section 1.2) are outlined. Following this, the positioning of the thesis and the methodically applied research design are presented (see Section 1.3). Subsequently, the structure of the thesis is described, including a brief description of the conducted research studies (see Section 1.4).

The **foundation** outlines the relevant thesis concepts. First, the technology of chatbots is discussed (see Section 2.1); this includes deriving a definition and a description of the features and usage characteristics. Afterward, the technical architecture of a typical chatbot is also detailed. Second, the operation area of the digital workplace is presented (see Section 2.2); a definition of the term is given

and the process perspective is described. Lastly, in Section 2.3 relevant scientific theories and models that are useful to survey the chatbot application in the business workplace context are briefly outlined.

Complex A	**Study I**	**State of the Art and Research Relevance**	***HICSS 2019***
	(Meyer von Wolff et al. 2019a)	***How May I Help You? – State of the Art and Open Research Questions for Chatbots at the Digital Workplace***	
	Main Contribution: Structured literature review to examine the research relevance. Identifying current research contributions, potentials, and objectives. Deriving open research questions.		
	Study II	**State of the Practice on Application Areas and Objectives**	***PAJAIS 2020***
	(Meyer von Wolff et al. 2020a)	***Chatbots at Digital Workplaces – A Grounded-Theory Approach for Surveying Application Areas and Objectives***	
	Main Contribution: Qualitative empirical cross-section interview study with experts for chatbot adoption and workplace design. Surveying usage scenarios, application areas, and objectives of chatbots at digital workplaces based on a grounded-theory process.		
	Study III	**State of the Practice on Influencing Factors and Challenges**	***WI 2021***
	(Meyer von Wolff et al. 2021b)	***Sorry, I Can't Understand You! – Influencing Factors and Challenges of Chatbots at Digital Workplaces***	
	Main Contribution: Qualitative empirical cross-section interview study with experts for chatbot adoption and workplace design. Surveying Influencing factors and challenges concerning chatbot adoption and application in workplace scenarios.		
Complex B	**Study IV**	**Requirements Analysis for Information Acquisition Chatbots**	***Conversations 2019***
	(Meyer von Wolff et al. 2020b)	***Chatbots for the Information Acquisition at Universities – A Student's View on the Application Area***	
	Main Contribution: Qualitative and quantitative questionnaire study to examine students' technical and content-related requirements of chatbots for information acquisition tasks in a university context.		
	Study V	**User Acceptance for IT-Support Chatbots**	***AMCIS 2020***
	(Meyer von Wolff et al. 2020d)	***The Students' View on IT-Support Chatbots at Universities – A Case-based Pilot Study***	
	Main Contribution: Design, development, and evaluation of a chatbot for IT-support tasks with three test scenarios that differ in scope and provided visualization. Survey of the users' perspective and usability of the chatbot.		
	Study VI	**Process-based Chatbots for Business Processes**	***AIS THCI (under review)***
	(Meyer von Wolff et al. Forthcoming)	***Designing Process-based Chatbots in Enterprises: The case of Business Travel Organization considering the Users' Perspective and Business Value***	
	Main Contribution: Design, development of the process-based chatbot *Spot*. Evaluation in terms of users' and organizational perspective based on a laboratory experiment with three participant groups based on a quantitative and qualitative questionnaire and expert interviews. Proposal of a nascent design theory for process-based chatbots at digital workplaces.		
Complex C	**Study VII**	**Procedure Model for Chatbot Projects in Business**	***HICSS 2022***
	(Meyer von Wolff et al. 2022a)	***Chatbot Introduction and Operation in Enterprises – A Design Science Research-based Structured Procedure Model for Chatbot Projects***	
	Main Contribution: Design and evaluation of a chatbot procedure model for the introduction and operation of chatbots in businesses. Two-step evaluation with adaptations to the constructed procedure model.		

Table 6 Overview of the Studies of the Thesis

The **conducted research studies** are described in Section 3. They are arranged in three research complexes required to develop a well-rounded impression of the application of chatbots at the digital workplace in businesses. Each research complex is introduced, and the contributions are briefly explained. Research complex A addresses the state of the art and practice for chatbots at digital workplaces to investigate the field of application and to identify starting points or research gaps for the studies in the following research complexes. Study I outlines the state of the art based on a literature review (Meyer von Wolff et al. 2019a, Study I, see Section 3A1). Grounding on that, in Study II and Study III the state of the practice, i.e., application areas, objectives, and challenges, is presented based on a qualitative empirical interview study (Meyer von Wolff et al. 2020a, Study II, see Section 3A2; Meyer

von Wolff et al. 2021b, Study III, see Section 3A3). Research complex B provides an overview of the design of chatbots for the digital workplace. Study IV outlines the requirements for information acquisition chatbots (Meyer von Wolff et al. 2020b, see Section 3B4). In Study V, the user acceptance for IT-support chatbots is surveyed (Meyer von Wolff et al. 2020d, see Section 3B5). In addition, some characteristics used for the development of the process-based chatbot in Study VI (Meyer von Wolff et al. Forthcoming, see Section 3B6) are preliminarily tested. Study VI comprises the development of the process-based chatbot artifact *Spot*, including an evaluation from the users' and business perspective concluding with the proposal of a nascent design theory. Research complex C summarizes the findings and knowledge acquired from the research project. A generalized procedure model is presented that can be used by businesses to conduct chatbot projects more successfully (Meyer von Wolff et al. 2022a, Study VII, see Section 3C7). An overview of the main studies used for the thesis, including its publication status and the main contribution, is presented in Table 6. An overview of all conducted studies that have been published during the course of the doctorate and their contribution to the individual research areas of this thesis is available in Appendix A1, showing that the findings have been reviewed by several reviewers in some cases.

The thesis ends with the **conclusion** in which the findings are summarized. First, in Section 4.1, the findings of the conducted research studies are presented based on the respective research complex to answer the main research questions as derived in the introduction. Second, the implications of the thesis' results for research and practice are outlined (see Section 4.2). Subsequently, the limitations of the thesis and the research studies are described (see Section 4.3), and, finally, opportunities for future and follow-up research are derived based on the presented results (see Section 4.4).

2 Foundations

In this chapter, the fundamental subjects of this thesis, chatbots and the digital workplace, as well as some relevant theories and models are discussed and explained for a common understanding (see Figure 3).

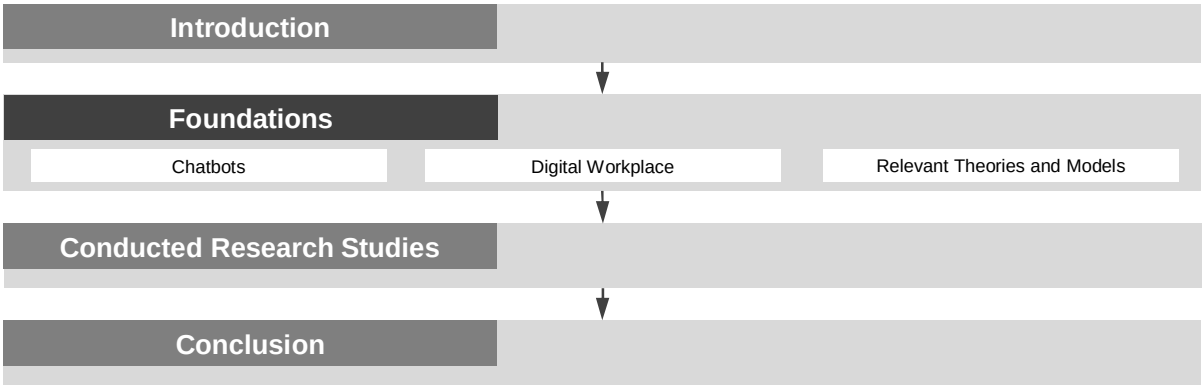

Figure 3 Structure of Chapter 2

First, in Section 2.1, the ecosystem chatbot is outlined. Therefore, a definition of chatbot and a brief overview of chatbots' features and usage characteristics are presented. In addition, the typical architecture of chatbots is described by pointing out the necessary components and their role in the ecosystem.

Second, in Section 2.2, the fundamentals of the digital workplace are discussed. Similar to the first section, the term is defined for a common understanding. Subsequently, a brief overview of office work and relevant processes is given.

Third, in Section 2.3 some relevant scientific theories that can be used to study the application of chatbots at the workplace are listed.

2.1 Chatbots

This section explains the ecosystem chatbot[1]. In doing so, a definition will be deduced (see Section 2.1.1). Afterward, features and usage characteristics of chatbots are briefly pointed out (see Section 2.1.2). In the last section, the chatbots' technical architecture is described (see Section 2.1.3).

2.1.1 Definition and Demarcation

Linguistically, the term chatbot is a composition of the two English terms "*to chat*", for conversations between two or more actors, and "*bot*", short for robot, an artificial entity with human capabilities (Braun 2003; Kusber 2017). In general, the concept describes an information system that can be operated by a dialog-based interface to execute functions (Lebeuf et al. 2018). Notably, the concept is not a new one. Instead, the first chatbots that achieved awareness in scientific research were *ELIZA*, developed by WEIZENBAUM (1966) in the 1960s to study natural language communication between an individual and their psychiatrist, and *ALICE,* developed by WALLACE (2009) in the 1990s to imitate a human and to compete in the *Turing Test*. Since these early developments, much research has been done, particularly in the last few years. This has been driven by current technological advancements and increased computing resources (Lewandowski et al. 2021; Maedche et al. 2019; Schuetzler et al. 2021). However, a negative side effect of this is that various synonymous terms have evolved in parallel. Especially in the last few years, in addition to *chatbot* or *chatterbot* (Deryugina 2010; Mikic Fonte et al. 2009a), the terms *smart personal assistant* (Winkler et al. 2019; Winkler et al. 2020b; Winkler/Roos 2019), *conversational agent* (Diederich et al. 2022; Elshan/Ebel 2020; Feng/Buxmann 2020; Gnewuch et al. 2017; Hobert/Meyer von Wolff 2019; Lewandowski et al. 2021), *digital employee assistant* (Manseau 2020), *digital assistant* (Maedche et al. 2019; Sarikaya 2017), and *conversational user interface* (Holmes et al. 2019; McTear 2004) have been used. Sometimes, chatbots are also classified as software agents (Braun 2003). Therefore, an exemplary selection of definitions is listed in Table 7 to help achieve a common understanding of the term chatbot.

Reference	Definition
(Weizenbaum 1966)	*"[…] a program which makes natural language conversation with a computer possible. […] What is important here is that the computer can read messages typed on the typewriter and respond by writing on the same instrument."*
(Braun 2003)	*"Chatbots, also chatterbots, [...] belong [...] to the category of software agents. [...] Chatbots enable humans to interact with computers based on natural language, regardless of whether this takes place via keyboard or voice recognition [...]. In doing so, they access a knowledge base [...] in which they select corresponding answers or actions by detecting matches of posed questions with the existing [...] question pool and output them to the questioner."* [note: translated from German]
(Al-Zubaide/Issa 2011)	*"Chatbot is a computer program that interacts with users using natural Languages. Chatbot systems allow to realize simply a dialogue system based on natural language. Therefore, they can be used as interfaces to a vastness of applications […]."*
(Berg 2013)	*"A speech dialog system enables a human user to access information and services offered via a computer or the Internet using spoken language as a means of interaction."* [note: translated from German]
(Angga et al. 2015)	*"Chatbot […] is able to interact with users in a given subject by using natural language. Normally, chatbot has the ability to answer questions from the user, provide comments, or bring a topic to be discussed with the user. […] Chatbot is a computer program, which conducts a conversation via auditory or textual interface. […] While some chatbots use natural language processing (NLP)*

[1] The content of this section is based on MEYER VON WOLFF/SCHUMANN (2018), and MEYER VON WOLFF/SCHUMANN (2019).

Reference	Definition
	as the basic algorithm, many simply scan for keyword from the input and give an appropriate reply with the most matching keyword from the database."
(Mallios/Bourbakis 2016)	*"Dialogue systems (DS), also known as conversational systems […] or conversational agents […], are computer systems that communicate with a human in spoken or written form. […] They can be incorporated into smart phones, web browsers, cars, robots and other computer systems and they can be utilized in various applications […]."*
(Sarikaya 2017)	*"A [Personal Digital Assistant (PDA)] is a metalayer of intelligence that sits on top of other services and applications and performs actions using these services and applications to fulfill the user's intent. […] PDAs make use of some core set of technologies, such as machine learning, speech recognition, [language understanding] LU, question answering (QA), dialog management (DM), language generation (LG), text-to-speech (TTS) synthesis, data mining, analytics, inference, and personalization."*
(Carayannopoulos 2018)	*"This [Chatbot] is an automated response system that has some limited artificial intelligence capabilities and appears as a contact on the [Instant Messaging] system. Its benefit is that the student can navigate through frequently encountered questions using an intuitive, conversation-like approach and locate information as it is needed, when it is needed."*
(Lebeuf et al. 2018)	*"From computer programs' earliest days, people have dreamed about programs that act, talk, and think like humans. Such programs could not only automate tasks that humans perform but also work with humans to solve intellectual tasks that can't be entirely automated […] The terms "chatbot," "chatterbot," and "bot" were interchangeably used to describe the realization of this vision quite early on. […] But now, they refer mostly to a conversational-style UI, an anthropomorphized script, or an agent that automates rote and tedious tasks."*
(Winkler et al. 2020b)	*"Smart Personal Assistants (SPAs) are computer agents that are able to assist users by engaging with them via natural dialogue […] The main functionality […] is typically housed as a cloud service that uses machine learning and natural language processing techniques to handle voice data […]."*
(Lewandowski et al. 2021)	*"We utilize the term [Conversational Agent (CA)] to describe all AI-based software systems that communicate with users, both employees and customers, via a natural language interface provided by natural language processing/understanding (NLP/NLU) technologies, such as via CA frameworks like RASA.ai including an intelligent communication and built-in self-learning component."*
(Diederich et al. 2022)	*"Different definitions are given for a [Conversational Agent (CA)], such as an agent that "interacts with users, turn by turn by using natural language", or "computer programs designed to respond to users in natural language, thereby mimicking conversations between people", or a concept to "achieve some result by conversing with a machine in a dialogic fashion, using natural language". While these definitions each highlight different characteristics of CAs, such as turn-taking or mimicking conversations, they all share the idea of natural language interaction. Thus, for this research, we consider CAs to be technological artifacts with which users interact through natural language, both in written and spoken form."*

Table 7 Selected Definitions of the Term Chatbot

Summarizing the selected definitions, chatbots can be defined as application or information systems that provide a natural language-based user interface to perform tasks. A chatbot is integrated into the users' communication channels or provided as a separate application (Diederich et al. 2022; Lebeuf et al. 2018; Weizenbaum 1966). While at the beginning the user interaction was conducted exclusively via textual or written input (Weizenbaum 1966), today audio or spoken inputs by the user are also possible (e.g., Angga et al. 2015; Mallios/Bourbakis 2016). Therefore, chatbots incorporate artificial intelligence and machine learning in terms of natural language processing to process the human input (Carayannopoulos 2018; Lewandowski et al. 2021; Sarikaya 2017; Winkler et al. 2020b), which is especially emphasized the more current the definition is. Thus, the chatbot can handle language in all forms, depending on its respective instantiation and implementation to provide its functionalities. In addition to NLP techniques, chatbots use an integrated knowledge database or provide application programming interfaces (API) to various integrated enterprise application systems (Al-Zubaide/Issa 2011; Angga et al. 2015; Braun 2003; Sarikaya 2017). In doing so, chatbots should both relieve the user of routine tasks and provide assistance with tasks that cannot be automated (Lebeuf et al. 2018). Based on the selected definitions (see Table 7) and the explanations, the following chatbot definition is used for this thesis:

> A **chatbot** is an information system that uses artificial intelligence technologies in terms of natural language processing to provide a text- or voice-based natural language user interface for human-computer interaction. Users can communicate intuitively and naturally with the chatbot to retrieve information or to execute (business) processes. Therefore, besides the chatbots' knowledge base, they are integrated with databases and (enterprise) application systems.

2.1.2 Features and Usage Characteristics

This section discusses the features and usage characteristics of chatbots. Based on the chatbot definition, essential **features** can be derived. Notably, a chatbot is characterized by its ***natural language capabilities***, allowing users to communicate with a chatbot in the language of their choice without having to adhere to specific input masks or control structures and elements (Berg 2014). To control the chatbot and its functionalities, only natural language-based expressions in terms of words, phrases, or sentences can be used (Braun 2003). Thus, a ***dialog-based interaction*** between a human and an information system is implied, that is, a human-computer interaction (Berg 2013; Diederich et al. 2022). The dialog can be initiated and controlled by the user so that the chatbot responds reactively to user inputs. Alternatively, the chatbot can proactively initiate a dialog. Hybrid or mixed approaches are also possible to provide a flexible and natural interaction. Misunderstandings or ambiguities should be clarified directly in the dialog by pointing out if inputs are recognized or not (Berg 2014). Furthermore, different ***input and output capabilities*** must be provided by the chatbot. As outlined in Section 2.1.1, both classical input via written text and the use of speech are possible (e.g., Braun 2003; Carayannopoulos 2018; Mallios/Bourbakis 2016; Weizenbaum 1966). Because the chatbot can be integrated into various communication channels, the output options should also be based on the input options and the possibilities of the respective communication channel. Chatbots increasingly constitute ***adaptive systems*** by using both available sensor and contextual data, for example, from the actual dialog or previous ones, to respond in a user- and situation-specific manner (Berg 2014; Henrich 2017). In addition, ***integration*** with existing (enterprise) application systems and databases is necessary. On one hand, chatbots provide natural language-based interfaces to the intended company systems and databases that are necessary for the respective chatbot use case. On the other hand, chatbots are accessed from the different systems at the workplace, for example, to provide assistance or clarify questions (Braun 2003). For this purpose, chatbots should also be integrated into the communication channels used, such as *WhatsApp* or *Slack*, or enterprise websites (Henrich 2017). In doing so, the chatbot adopts the respective features of the chosen channel, such as portability or device independence when using a messaging service. Lastly, ***data security and data protection regulations*** must be taken into account if the systems are to be used in the company. Thus, especially private-known chatbots such as *Amazon Alexa*, *Apple Siri,* and *Google Assistant* contradict this, as they constitute public systems with a company-external cloud infrastructure. The risk exists that (critical) corporate data can flow out of the company (Cowan et al. 2017; Lewandowski et al. 2021). In addition, these solutions are proprietary, which in some cases does not allow integration of third-party applications, adoption to a company, or integration with company information systems (Cowan et al. 2017).

Consequently, based on the described features, the chatbots' definition, and based on the features of software agents (Mostafa et al. 2017; Nwana 1996; Wooldridge/Jennings 1995), to which chatbots can be classified (Braun 2003), the following **usage characteristics** can be deduced:

- ***Natural language-based communication***: A chatbot provides a natural language-based user interface to (enterprise) applications and resources so that a user can control them in an intuitive and familiar way, corresponding to a real conversation.
- ***Reactive***: Chatbots are aware of their environment, e.g., the physical environment or user input, and respond to appropriate changes in a timely manner.
- ***Proactive and Autonomous***: Chatbots not only respond to user input but can also react autonomously to changing environmental variables and can take the initiative.
- ***Adaptive and Learning***: Chatbots possess contextual knowledge, e.g., the goal of the communication or users' preferences, and use it for the respective interaction with the user. Previous conversations or outcomes can also be fed back into the knowledge base for use in future interactions, e.g., to adapt to a respective user.
- ***Integration***: Chatbots are integrated into existing communication channels and applications and provide an interface to a variety of different (enterprise) resources and application systems.

2.1.3 Technical Architecture

In the following, the typical technical architecture of a chatbot is outlined by describing the components necessary to provide the functionalities. Typically, chatbots consist of technical components for natural language processing and a dialog manager to process the requests and determine the response or action (see Figure 4). In addition to the chatbot's own knowledge base the chatbot is trained on, the dialog manager accesses a backend for this, e.g., external databases, (enterprise) application systems, internet pages, or different APIs. Optionally, depending on the scope and complexity, components for the recognition of spoken language as well as the generation of audio outputs can be used to communicate with a chatbot in addition to textual inputs and outputs (Berg 2013; Berg 2014; Mallios/Bourbakis 2016).

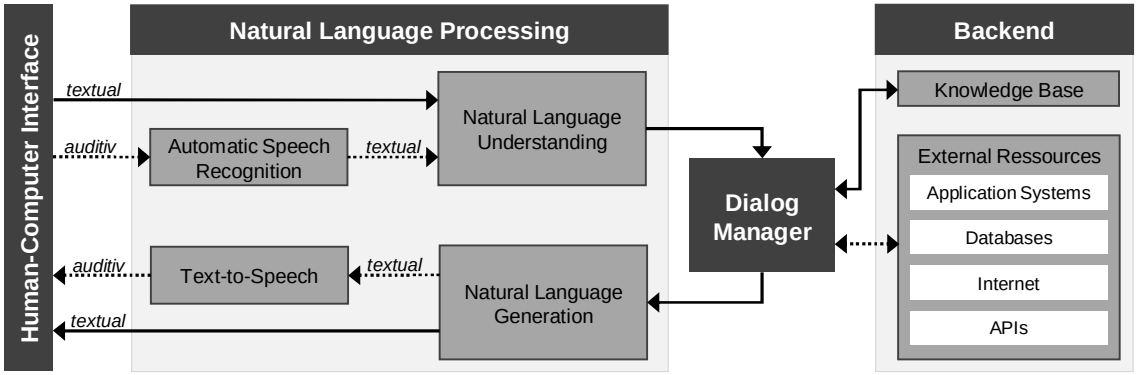

Figure 4 Technical Architecture of a Chatbot[2]

Through the provided **human-computer interface**, typically a graphical user interface (GUI), the interaction with the chatbot is carried out via textual inputs or spoken language (see Section 2.1.1; see

[2] According to BERG (2013), BERG (2014), and MALLIOS/BOURBAKIS (2016).

Figure 4). If the input is audio or spoken, it must be preprocessed by an **automated speech recognition** component. This component transforms the audio pattern into a machine-readable text that can be processed by the chatbot's algorithm later on (Berg 2013). Afterward, the machine-readable form, or if the input was initially text-based, is analyzed and interpreted by the **natural language understanding** (NLU) component (Berg 2014) to identify the user's intent. The user's input is thereby decomposed into its individual elements and examined for patterns (Kusber 2017). This is done using methods such as stemming, language identification (e.g., English or German), tokenization (converting the message into a list of characters), cleaning the query of stop words, and case folding (converting upper case letters into lower case letters) (Putri et al. 2019). After these methods are applied, the component uses deep learning technologies to compare the result with the previously trained chatbots' knowledge to determine the user's intent (Kvale et al. 2020).

The **dialog manager** then processes these results. This component represents the actual application logic of the whole chatbot and the connection to integrated application systems and databases of the backend with which the user's intent can be satisfied. The dialog manager coordinates the dialog flow and decides how to respond to the user input. Therefore, the results of the NLP component, that is, the user's intent, are processed to execute the requested action, obtain information, and make decisions about the subsequent dialog flows and steps. Based on the accordance of the user input with the trained knowledge, a respective output is triggered or an action is performed. If there is no match or if there is ambiguity, the dialog manager can initiate strategies to discover the user's intent (Berg 2013; Mallios/Bourbakis 2016).

The **backend** typically consists of a knowledge database with information and statements the chatbot can use to answer the user (Mikic Fonte et al. 2016). Typical forms of knowledge representation are nowadays question-answer pairs (Nursetyo et al. 2018), *Artificial Intelligence Markup Language* (AIML) files (Mikic Fonte et al. 2009b; Ranoliya et al. 2017), or natural language-based text with a dictionary-like structure (Kurohashi/Higasa 2000). In addition to context-specific information, such as intent and media, e.g., images or videos, the knowledge base can also contain small talk (Hobert/Berens 2020). To store the knowledge, among others, relational databases (Setiaji/Wibowo 2016), knowledge graphs (Herrera et al. 2019), ontology-based databases (Al-Zubaide/Issa 2011; Augello et al. 2012), or cloud-based databases, i.e., the data no longer needs to be stored locally or on a terminal (Kusber 2017), are typically used. Besides databases, the dialog manager can also access integrated business systems or extract information from web pages (Berg 2013; Følstad/Brandtzæg 2017; Reshmi/Balakrishnan 2016).

Depending on the dialog manager, the determined information or feedback on triggered actions are reported back to the user. Consequently, in the **natural language generation** (NLG) an output, i.e., an answer or a follow-up question for clarification or to determine the subsequent dialog, is created (Berg 2014). This may include text, images, videos, and control elements (Feine et al. 2020a; Kusber 2017). If the initial input was audio or if audio outputs are wanted, the output can then finally be converted into spoken language with the help of a **text-to-speech** (TTS) component (Mallios/Bourbakis 2016).

For the purposes of this research, chatbots are viewed as a combination of the different components as outlined in this section. It is not examined how each individual component is to be designed but rather

how the combination of the components can be used in the best possible way for an application at the workplace. In doing so, the most current and available state of the art regarding the individual components is used and applied. Additionally, in this thesis, chatbots are surveyed holistically, in accordance with the general system theory (von Bertalanffy 1968). Hence, the chatbot is considered as a black box to examine its behavior and applicability at the digital workplace (Bunge 1963; Shawar/Atwell 2007b). Furthermore, as differentiated by MAEDCHE ET AL. (2019), in the thesis chatbots are viewed as a socio-technical information system to survey the capabilities in the interplay between users, tasks, and technologies in a given context (Goodhue/Thompson 1995). The technology is the chatbot itself, while the users are employees or customers using the chatbot for a workplace task at the digital workplace (context). Therefore, as not all the individual components are examined or are research aspects of the thesis, the chatbot will not be surveyed from the application class perspective (Maedche et al. 2019).

2.2 Digital Workplace

The following section covers the subject area of the digital workplace.[3] In the next section, a definition will be deduced (see Section 2.2.1). Afterward, the process perspective of digital office work is outlined (see Section 2.2.2).

2.2.1 Definition and Demarcation

This research project investigates the application of chatbots at the digital workplace. According to BEGAU ET AL. (1993), BODENWINKLER (1984), and SZYPERSKI ET AL. (1982), among others, the (office) workplace is not seen as a place but as a "virtual" summary of activities on "intellectual objects", that is, information. There is no stereotypical office workplace, but rather it depends on the circumstances and tasks for which an employee is responsible. What workplaces have in common is that they are places where information is processed, decisions are made, and work is done (Byström et al. 2017). For the present research project, this focus on working with information is defined as office work at the digital workplace.

The knowledge on office work – or office communication[4] – is based on early research by BODENWINKLER (1984), NIPPA (1988), and SZYPERSKI ET AL. (1982), among others. These research contributions are used as the basis for this work, as there have been no fundamental changes in organizational circumstances over the years. This is in contrast to the technical design of workplaces where digitalization has turned office work into digital work (Byström et al. 2017; White 2012), which is nowadays also known as knowledge work (North 2014). Consequently, in the following office work and digital work are considered synonymous. Various definitions are given in the literature; therefore a common definition is needed for this thesis. A selection of definitions is listed in Table 8

[3] Section 2.2.1 and Section 2.2.2 are based on MEYER VON WOLFF/SCHUMANN (2018), and MEYER VON WOLFF/SCHUMANN (2019).

[4] For the term office communication see, among others, BEGAU ET AL. (1993), BODENWINKLER (1984), and SZYPERSKI ET AL. (1982). Based on the explanations of these authors, the two terms are used synonymously in this paper.

Reference	Definition
(Szyperski et al. 1982)	*"Office communication characterizes the work in the office, which essentially consists of all sub-processes of communication (in the broader sense) between people (or people and machines)."* [note: translated from German]
(Bodenwinkler 1984)	*"The office area is the field of work in which information transformation processes are carried out by people, supported by technical and information technology equipment."* [note: translated from German]
(Nippa 1988)	*"Office communication comprises all information and communication tasks and activities within a company which serve to control and regulate the company and which can be influenced by organizational, personnel and technical design measures."* [note: translated from German]
(Begau et al. 1993)	*"The view of the office as the center of information processing and communication defines the office as the operational task area in which information is primarily procured. From a systems theory point of view, the office is regarded as a subsystem of the enterprise, the design of which depends on situational influencing factors and requires a structural adaptation of information technology. It forms the interface between the individual functional areas of an enterprise and its environment [...]. The office controls the operational adaptation processes by means of an effective information system, which informs the organizational participants about internal and external changes and initiates adaptation processes. Associated with this are sometimes complex processes of formal, content, temporal and spatial transformation of information. [...] The office area is therefore also regarded as an information infrastructure for the primary performance processes of a company. Thus, the office area integrates all operational functional areas and tasks, which serve the guidance, regulation and control of the enterprise and covers thus both "classical" office tasks and typical management tasks."* [note: translated from German]
(White 2012)	*"A digital workplace enables any employee to complete a task, share information and work as a member of a team with other employees in the organization and in any partner organization on a totally location-independent basis for all the parties concerned."*
(DGUV 2015)	*"Office workplace is a workplace where information is generated, elaborated, processed, evaluated, received or forwarded. For example, planning, development, consulting, management, administrative or communication activities as well as functions supporting these activities are carried out at the workplace."* [note: translated from German]
(Lestarini et al. 2015)	*„Digital workplace is a coordination between technology, process and people. Digital workplace enables employees to work effectively from anywhere, at any time, on any device, and it provides an internet-like participative mode and user experience no matter where their location. Digital workplace creates employees' ability to do their job by collaborating, communicating and connecting with others."*
(Byström et al. 2017)	*"The stereotypical office setting is a common experience for many of us and those of us who have an office will probably still think of this space when we are asked to imagine `where do we work`. But where we actually conduct our work may vary across many spaces depending on the circumstances and the tasks in which we are engaged. Our workplaces therefore are not simply a matter of place but of the various spaces in which we conduct our information work, how we decide (or have decided for us) what and where work happens, and what information and information technology is available within those spaces."*
(Dery et al. 2017)	*"We define digital workplaces as the physical, cultural and digital arrangements that simplify working life in complex, dynamic and often unstructured working environments."*
(Lackes/Siepermann 2017)	*"Activities in the office sector that are largely characterized by the handling of information (generation, processing, transmission, etc.). Office work consists predominantly [...] of communication processes."* [note: translated from German]

Table 8 Selected Definitions of the Term Digital Workplace

All the definitions presented have in common that office work or the office workplace includes activities that are primarily based on information and that search for, use, transform, and file this information (e.g., Begau et al. 1993; Bodenwinkler 1984). It is also indicated that a wide variety of activities are involved in office work in order to carry out information processing processes (e.g., Begau et al. 1993; Lackes/Siepermann 2017). While the definitions mentioned are similar in these respects, the perspectives adopted by the authors differ in some cases. For example, authors of older publications, such as SZYPERSKI ET AL. (1982), consider communication as an integral part of office work. This can be justified by the fact that in the corresponding publications the office workplace was considered from the communication point of view. Thus, communication is not limited to people but also includes communication with the existing application systems (Szyperski et al. 1982). This focus on application systems is primarily addressed in recent publications, including WHITE (2012), and LESTARINI ET AL. (2015). By considering this digital, application system work (see also DAVISON/OU (2014)), the digital

workplace is no longer presented as a place but rather as “digital” coordination between a wide variety of technologies, processes, and people for the easy performance of work tasks in dynamic and unstructured work environments (Byström et al. 2017; Dery et al. 2017). This enables employees to exchange information (partly location independent and mobile), collaborate with other employees or application systems, and complete the tasks involved. Building on the definitions discussed above, in this paper the term digital workplace is defined as follows:

> The **digital workplace** combines (IT) technologies, processes, and people to carry out information processing within and between companies. The focus is on working with information and a distinct relevance of communication between the people involved as well as between people and the different (enterprise) application systems. Usually, the digital workplace is not limited to one location and represents the intersection between the different departments of a company.

2.2.2 Process Perspective of Office Work

A characteristic feature of digital office work is working with information carried out with the aid of application systems, which is strongly communication-oriented and encompass a wide variety of activities. The superordinate and entrepreneurial function of the office area includes tasks and functions for the goal-oriented control and regulation of corporate activities (Nippa 1988). The focus on information as a work object is nowadays also known as knowledge work (Hübschen 2015; North 2014). Employees use information and application systems as work tools to generate new information with the help of knowledge. In contrast, at the production workplace, a physical product or material is used as input and is processed with the help of physical tools. The result is a new or similar physical product or service (North 2014) (see Table 9).

Criteria	Office Work	Physical Work
Input	Information	Physical input
Output	Information	Physical product or service on a product
Work object	Intangible	Physical
Work equipment	Information and communication systems	Physical tools
Work content	Refining information through knowledge	Processing of physical input

Table 9 Office Work vs. Physical Work[5]

Thus, office work is the part within a company that focuses on immaterial, digital work with information. Therefore, it is to be distinguished from mechanical or physical work, as presented, for example, in HOBERT (2018) in the context of production in the industrial sector. The present thesis particularly focuses on the information processing procedures with the help of application systems within a company. In specific, the focus is on the processes working with information and on support processes (Rüegg-Stürm 2002; Rüegg-Stürm 2005; Wölfle 2005; Wölfle 2006) (see Figure 5; dark grey), as in these processes the intangible value creation takes place in terms of office work (see Section 2.2.1; see Table 9). The physical and the management processes of a company are not within the scope of this thesis. Within the first, the primary value creation consists of manufacturing, assembly, or repair of a

[5] According to NORTH (2014).

physical product, i.e., the conversion of physical input factors into physical goods (Bloech et al. 2014), although various application systems are in use, e.g., for information provision or (machine) control, such as cyber-physical systems (Freier 2020), smart watches (Zenker 2021), or smart glasses (Hobert 2018). Chatbots for factory and machine control (Kassner et al. 2017) are out of the scope of this work, as they are only used for support and not for value creation in the sense of office work. Such deployment scenarios for chatbots will therefore not be considered further in the remainder of the thesis. Analogously, management processes will not be considered further, as they comprise overarching activities of planning, organization, and control of the entire enterprise (Rüegg-Stürm 2002; Rüegg-Stürm 2005). Nevertheless, such tasks can be addressed indirectly by chatbots, for example, by the highlighted support processes in Figure 5.

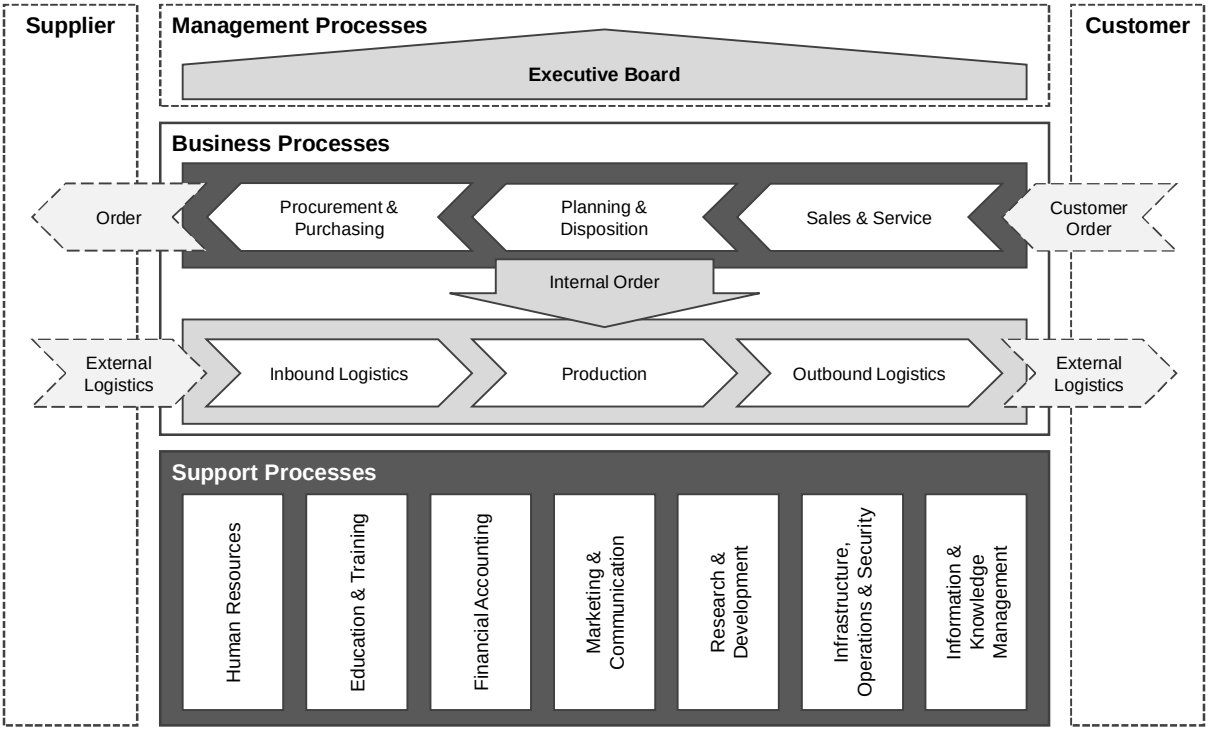

Figure 5 Functional Areas of Office Work[6]

2.3 Relevant Theories and Models for Chatbot Applications at the Digital Workplace

In addition to the deployment scenario of the digital workplace and the respective processes, established scientific theories and models also exist to be drawn upon when examining the adoption and application of technologies in the workplace, in this case for chatbots. This can be done from both the users' and the organizational viewpoints. In the following section, selected theories and models that have proven to be particularly outstanding over the years are briefly presented. If there is already chatbot-related research that uses these theories, it will also be addressed.

[6] Translated according to WÖLFLE (2006).

From the users' point of view, a common scientific approach is to survey user acceptance of a new information system in order to determine its possible success. The **Technology Acceptance Model** (TAM) has received particular attention in this regard and is considered a well-regarded and well-established option for acceptance testing and assessment. The original version established by DAVIS (1989) explains usage behavior, with the constructs of perceived usefulness and perceived ease of use influencing the willingness to use a system, which ideally results in a behavior intention to use and an actual system use. This was applied, for instance, by PARK (2009) to survey the behavioral intention to use e-learning among students. In addition, CONSTANTINIDES ET AL. (2013) used the model to survey the use of social networking sites as business tools, and TRIPATHI (2019) used it in the context of cloud computing adoption. In the chatbot context, RIETZ ET AL. (2019) built upon TAM to identify the impact of anthropomorphic and functional design features, and CHEN ET AL. (2020) used TAM to assess the acceptance of a chatbot for learning Chinese. In recent years, the original TAM was extended two times. It was extended in TAM2 (Venkatesh/Davis 2000), by external influencing factors to support longitudinal studies and in TAM3 (Venkatesh/Bala 2008) to further include anchor and adjustment constructs. Consequently, TAM and its successors represent a comprehensive model for individual acceptance measurement that can be used and adapted for a wide variety of research studies, such as chatbot research in businesses.

Additionally, regarding the individual perspective and particularly the interaction of users with information systems, the **Computers Are Social Actors** (CASA) paradigm has emerged (Nass et al. 1994). According to the theory, users apply social rules and expectations to their interaction with a computer or rather an information system. Therefore, social psychology, communication, and sociology literature should be considered when studying human-computer interaction and associated design (Nass et al. 1994). Particularly in the field of human-computer interaction, the theory is used as a theoretical foundation to explain the effects of social cues on the perception of human-like technologies (Gnewuch et al. 2018). In the chatbot context, this paradigm should also gain significance, as the computer interaction is based on a natural language dialog that creates, even more, a representation of a social actor. For artificial intelligence and robotics, the paradigm was already applied (Edwards et al. 2014; Lee et al. 2005). For instance, in the chatbot context, HO ET AL. (2018) applied the computer as a social actor paradigm; DIEDERICH ET AL. (2022) and ZHANG ET AL. (2020) also refer to this paradigm in their research on chatbots.

From the organizational perspective, the **Information System Success Model** (ISSM) was established (DeLone/McLean 1992) to provide a general and comprehensive definition of information system success. It was updated a few years later (DeLone/McLean 2003). Herewith, a system can be evaluated in terms of information, system, and service quality that affects the use and user satisfaction. Thus, user satisfaction and use of an information system can be determined. This includes the resulting benefits, both positive and negative, which in turn influence usage and satisfaction. ISSM has been successfully applied. For instance, ALSHIBLY (2014) used it to assess the success of electronic human resource management, FREEZE ET AL. (2010) used it to measure e-learning success, and YU/QIAN (2018) used it to measure the success of electronic health records. In the chatbot domain, ASHFAQ ET AL. (2020) used ISSM for service agent chatbots.

Notably to mention is also the **Unified Theory of Acceptance and Use of Technology** (UTAUT) to survey information system success or influence from the organizational perspective (Venkatesh et al. 2016). This theory was developed by synthesizing models for predicting user acceptance, e.g., technology acceptance model, and the use of IT, e.g., theory of planned behavior, to predict behavioral intention to use a technology and actual use, primarily in an organizational context (Venkatesh et al. 2016). For instance, LAUMER ET AL. (2019a) used UTAUT for the case of healthcare chatbots.

Furthermore, the process by which a company adopts and implements technological innovations or information systems, i.e., chatbots, is often subject to hindering or supporting factors. In this regard, the **Technology-Organization-Environment** (TOE) **framework** by DEPIETRO ET AL. (1990) has often been used to identify factors that affect the adoption decision (Oliveira/Martins 2011). The model considers factors from the technical, organizational, and environmental domains and identifies their influence on the adoption. Consequently, the three factors influence the way a company adopts new technology. This was applied by, for instance, ZHU ET AL. (2003) in investigating influencing or hindering factors for e-business adoption at the firm level. A study by BORGMAN ET AL. (2013) used the TOE framework in an expert interview study to identify influencing factors for cloud computing among adopters and non-adopters. Recently, the TOE framework was refined and extended by an individual domain, which explicitly covers the factors of, for example, future users, decision-makers for adoption, and technology supporters. Subsequently, the **Technology-Organizational-Individual-Environmental** (TOIE) **framework** was created (Awa et al. 2017; Rosli et al. 2012). In the chatbot domain, RODRÍGUEZ CARDONA ET AL. (2019) applied the framework, even if the individual category was highlighted only implicitly, for the application of chatbots in the insurance sector.

There are also scientific theories and models available to investigate viable application areas for chatbots at the digital workplace. One approach at the user level to be mentioned is the **Task-Technology Fit Theory** (Goodhue/Thompson 1995). The theory constitutes that technology is more likely to have a positive impact if the technical capabilities match the tasks' requirements. Thus, the theory is a predictor for performance and effectiveness and surveys the importance of the fit between technologies and users' tasks to achieve individual performance impacts from the technology used. For instance, ALKHALIFAH/D'AMBRA (2011) applied the theory to the adoption of identity management systems. Additionally, PILLAI/SIVATHANU (2020) applied the theory together with TAM to the adoption of artificial intelligence for talent acquisition in organizations. Another approach, which addresses the organizational level, is the **Fit-Viability Theory** (Liang et al. 2007). Based partly on the *Task-Technology Fit Theory*, this theory examines the performance of technology adoption in organizations. Hence, the fit, i.e., the match of the technology with the needs of a task, and the viability, i.e., the extent to which the infrastructure of the organization is ready for adoption, are considered.

3 Conducted Research Studies

In this chapter, the seven conducted research studies are presented.[7] As shown in Figure 6, the studies are arranged in three research complexes.

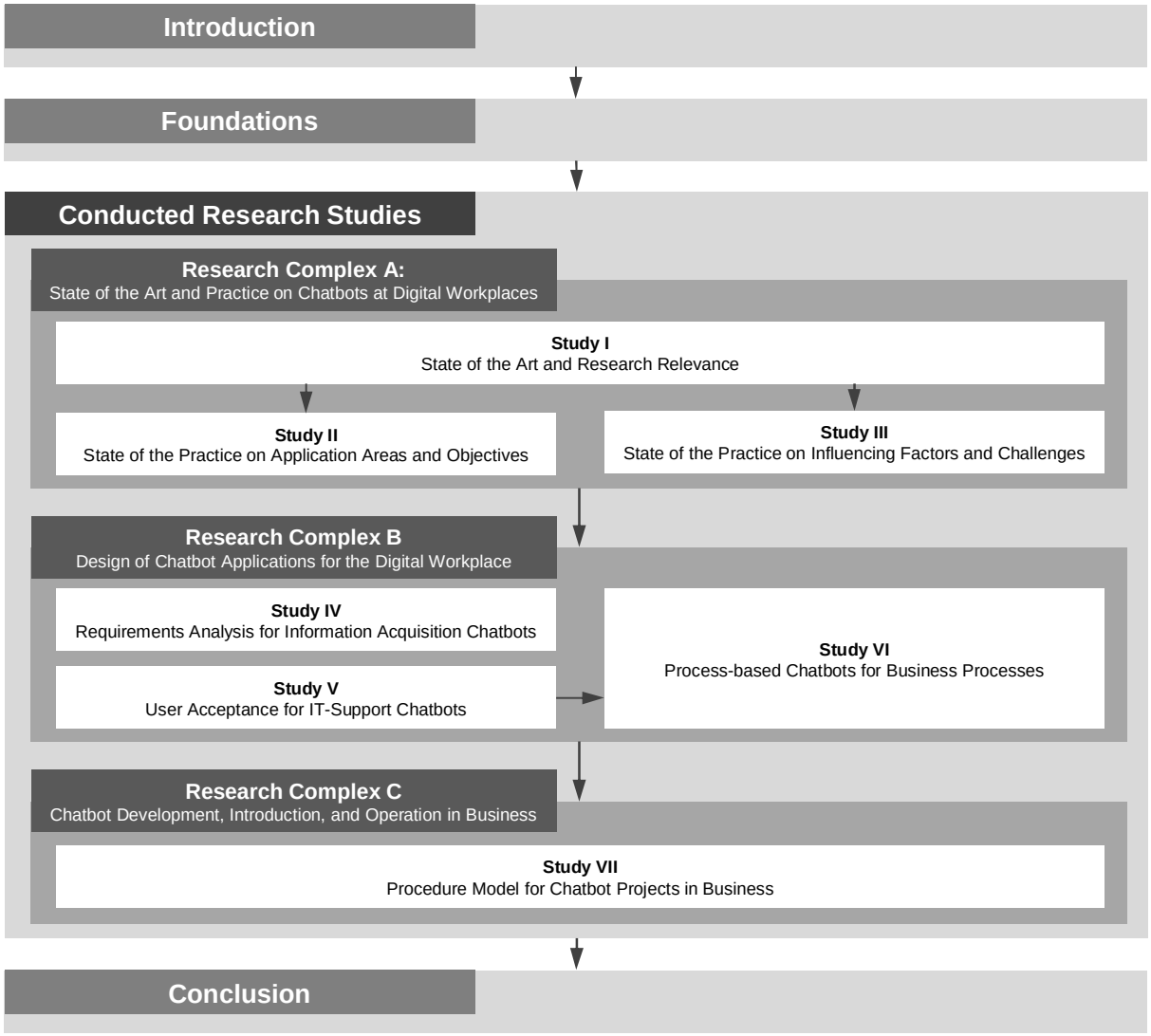

Figure 6 Structure of Chapter 3

At first, in research complex A, the scientific and practical foundation for the subsequent studies is presented. Therefore, in Study I, the state of the art and the relevance for research are described (see Section 3A1). Following this, in Study II, the state of the practice is outlined by highlighting application areas and objectives (see Section 3A2). Lastly, in Study III, influencing factors and the challenges of a chatbot application are discussed (see Section 3A3).

[7] To ensure a uniform, consistent, and error-free presentation, the studies have been slightly adjusted without making changes to the content of the published and referenced original version. This includes orthographical correction (e.g., missing or double words, punctuation), stylistic improvements (e.g., connecting words), standardization of the appearance (e.g., captions, presentation, figures and tables, introduction of consistent abbreviations), and the introduction and adaptation of (cross-)links.

At second, research complex B addresses the design of chatbot applications for digital workplaces. In doing so, in Study IV, requirements for information acquisition chatbots are examined (see Section 3B4). Additionally, in Study V, users' acceptance and assessment of IT-support chatbots are surveyed (see Section 3B5). Lastly, in Study VI, a *Design Science Research* study is presented to design a process-based chatbot for the digital workplace (see Section 3B6).

At last, in research complex C, a generalized procedure model for chatbot projects based on a *Design Science Research* study is described to support and guide practice to conduct successful chatbot operations in businesses (Study VII, see Section 3C7).

A Research Complex: State of the Art and Practice on Chatbots at Digital Workplaces

To comprehensively survey the application of chatbots at digital workplaces in business, it is necessary to create a well-established foundation for the subsequent studies. In doing so, the research relevance must be verified and possible starting points for the subsequent research studies must be identified. Therefore, in the first research complex, light is shed on the state of the art to examine the current scientific literature and the body of knowledge on chatbot applications and adoption for the workplace from the scientific perspective. The practice perspective is also included by surveying the current state of chatbot operation from a company perspective. Consequently, the research question on which research complex A is based addresses the state of the art and practice on chatbots at digital workplaces [MRQ1] and is subdivided into four sub-meta research questions [MRQ1.1-4] (see Table 1) addressing the four relevant aspects to lay the foundation.

First, the state of the art on chatbots for digital workplaces is examined [MRQ1.1]. Therefore, in Study I, the sub-meta research question is refined and addressed by two further research questions (see Figure 7) (Meyer von Wolff et al. 2019a). Based on a structured literature review, the current scientific contributions on chatbots at digital workplaces are systematized to give an overview of the existing research areas and trends in the chatbot domain [$RQ_1$1]. In addition and based on the respective results of the literature review, existing open research questions or research gaps are derived to point out starting points for subsequent studies specific, and to highlight research needs for the scientific community in general [$RQ_1$2].

Second, viable application areas for chatbots at digital workplaces must be surveyed to be able to provide chatbots [MRQ1.2]. This sub-meta research question is refined by three further research questions of two studies. Based on the structured literature review of Study I, application areas and potential use cases mentioned in the scientific literature are systematized and described [$RQ_1$1] (Meyer von Wolff et al. 2019a). Study II examines the practice perspective (Meyer von Wolff et al. 2020a) based on a qualitative cross-section interview study with industry experts. Possible usage scenarios are described in terms of technical functions that can be conducted with chatbots at the workplace independently of a specific application area [$RQ_2$1]. Furthermore, actual application areas that exist in a company both within a division and across divisions are described [$RQ_2$2]. In addition, the relationship between the usage scenarios and the application areas is also outlined.

Third, the objectives targeted by a chatbot application at digital workplaces are examined [MRQ1.3]. This sub-meta research question is refined by two research questions of two independent studies. Based again on the structured literature review of Study I the objectives mentioned in scientific contributions are systematized and described [$RQ_1$1] (Meyer von Wolff et al. 2019a). In addition, based on the interview study of Study II, the practice perspective on objectives is also examined [$RQ_2$3] (Meyer von Wolff et al. 2020a). In doing so, the relationships among the objectives are shown and the objectives are outlined based on the categories direct, mid-level, and indirect.

Fourth, it is necessary to examine the overall constraints for a chatbot application at digital workplaces [MRQ1.4]. Therefore, in Study III (Meyer von Wolff et al. 2021b) the sub-meta research question is refined by two further research questions. Based on the same interview study of Study II, the factors influencing a chatbot adoption at digital workplaces are outlined based on the technical, organizational, individual, and environmental categories of the *Technology-Organizational-Individual-Environmental* framework (DePietro et al. 1990; Rosli et al. 2012) [$RQ_3$1]. Regarding the respective influencing factors, the existing challenges that need to be addressed for a successful chatbot application are also described [$RQ_3$2].

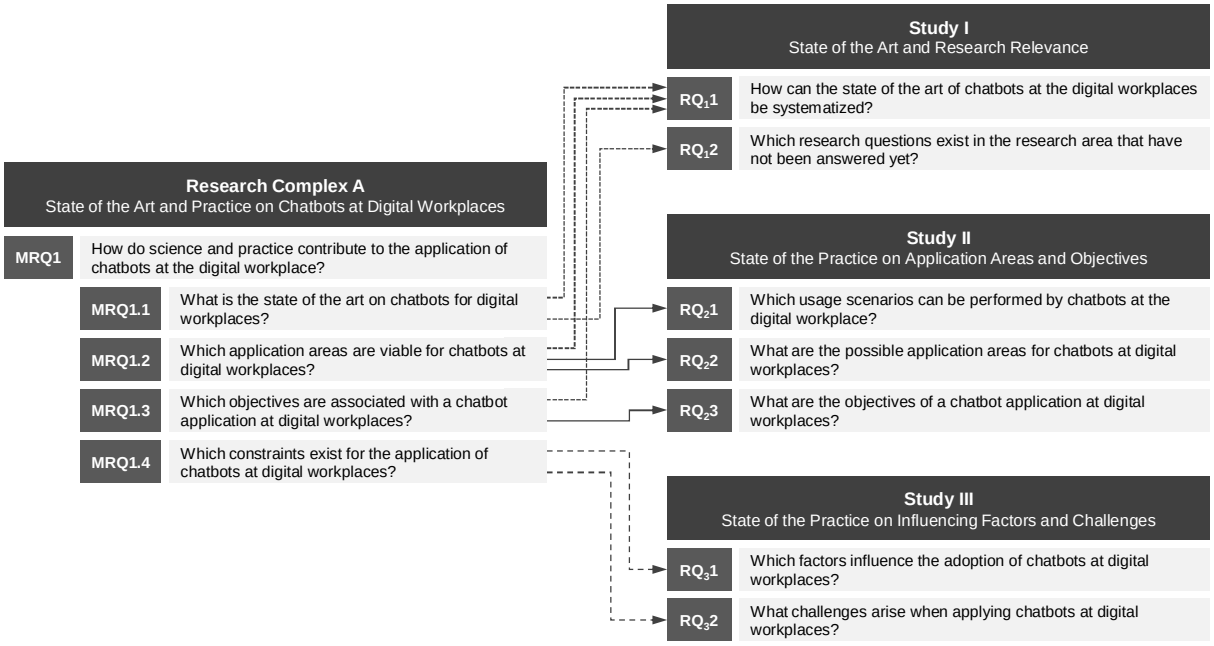

Figure 7 Overview of the Studies and their Research Questions of Research Complex A

For each study, supplementary information is provided in the appendix. This includes the search strings, the classification matrix, and further overviews of the relevant literature (some descriptive statistics and the allocation of the literature to the application areas and objectives) of Study I in Appendix A2. Additionally, for Study II and Study III, the prequestionnaire for the interview study, the original interview guideline, and the classification matrix of the interviews are available in Appendix A3. Appendix A3 also includes exemplary quotes relating to influencing factors and challenges of Study III.

1 State of the Art and Research Relevance

> How May I Help You? – State of the Art and Open Research Questions for Chatbots at the Digital Workplace

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How May I Help You? – State of the Art and Open Research Questions for Chatbots at the Digital Workplace

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Abstract

Chatbots become quite hyped in recent times as they can provide an intuitive and easy-to-use natural language human-computer interface. Nevertheless, they are not yet widespread in enterprises. Corresponding application areas for collaboration at digital work-places are lacking and prior research contributions on this topic are limited. In this research paper, we aim at surveying the state of the art as well as showing future research topics. Thus, we conducted a structured literature review and showed that only few first research contributions exist. We also outline current potentials and objectives of chatbot applications. In the discussion of the results of our structured literature review, we show that research gaps are present. To tackle the research gaps, we derive open research questions.

1. Introduction

In recent years, a growing digitalization of the economy can be observed. In particular, this influences enterprises and the way how employees work at office workplaces. Based on this increasing use of innovative technologies, the workplace of the future turns into a digital-enhanced workplace [33, 35]. Established paper-based working practices vanish and new forms of collaboration as well as office and working structures are spreading. Employees demand the use of new technologies at the workplace that they know from private use [34, 35, 40, 65]. In addition, a second "megatrend" should be considered: the distribution of messaging-services for communication and collaboration among employees in the day-to-day business [22]. This influence of location- and device-independent communication also effects and shapes the digital workplace. Despite the advantages of using innovative technologies, this results in an increasing number of communication channels and corresponding information sources. Employees also tend to use multiple information systems in their day-to-day business simultaneously, which leads to an application overload. Thus, employees spend an increasing amount of time for searching, editing or sharing of information [52, 65], which could further affect the employees' productivity in their work tasks negatively [12, 38].

To address these problems, it is necessary to filter information to avoid information overloads as well as to reduce the workload during daily tasks by providing appropriate assistance. One promising technology for this is the use of artificial intelligence in the form of chatbots. They provide a human-computer interface using natural language-based dialogs and are capable of assisting or automating tasks as well as filtering and providing information [20, 54, 55]. Although practitioners assume that chatbots can influence employees' productivity positively, the technology itself is still in an early development stage. Even though dialog-based systems (e.g., Amazon's Alexa or Ikea's Anna) are popular among consumers, chatbots are currently not yet widespread in enterprises and corresponding application areas are lacking [10, 36]. This is also reflected in the scientific knowledge base, as prior research is limited in this infancy research area. Therefore, we aim at providing an in-depth analysis of the current state of the art as an entry point for future research [24]. Based on a structured literature review, we analyze the current literature, describe the outcomes and postulate open research questions. Thus, we ask the following research questions:

RQ1: How can the state of the art of chatbots at the digital workplaces be systematized?

RQ2: Which research questions exist in the research area that have not been answered yet?

To answer these questions, the remainder is structured as follows: Below, we present the theoretical foundations in section 2 and describe the methodical approach of our literature review in section 3. In section 4, we outline the results of our literature review, discuss them in section 5 and postulate open research questions in section 6. We summarize our findings in section 7.

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Abstract Chatbots become quite hyped in recent times as they can provide an intuitive and easy-to-use natural language human-computer interface. Nevertheless, they are not yet widespread in enterprises. Corresponding application areas for collaboration at digital work-places are lacking and prior research contributions on this topic are limited. In this research paper, we aim at surveying the state of the art as well as showing future research topics. Thus, we conducted a structured literature review and showed that only few first research contributions exist. We also outline current potentials and objectives of chatbot applications. In the discussion of the results of our structured literature review, we show that research gaps are present. To tackle the research gaps, we derive open research questions.

Keywords Chatbot, Digital Workplace, Human Computer Interaction, Conversational Agent.

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1.1 Introduction

In recent years, a growing digitalization of the economy can be observed. In particular, this influences enterprises and the way how employees work at office workplaces. Based on this increasing use of innovative technologies, the workplace of the future turns into a digital-enhanced workplace (Klaffke 2016; Köffer 2015). Established paper-based working practices vanish and new forms of collaboration, as well as office and working structures, are spreading. Employees demand the use of new technologies at the workplace that they know from private use (Klaffke/Reinheimer 2016; Köffer 2015; Lestarini et al. 2015; White 2012). In addition, a second "megatrend" should be considered: the distribution of messaging-services for communication and collaboration among employees in the day-to-day business (Gentsch 2018). This influence of location- and device-independent communication also affects and shapes the digital workplace. Despite the advantages of using innovative technologies, this results in an increasing number of communication channels and corresponding information sources. Employees also tend to use multiple information systems in their day-to-day business simultaneously, which leads to an application overload. Thus, employees spend an increasing amount of time for searching, editing, or sharing of information (Russell 2012; White 2012), which could further affect the employees' productivity in their work tasks negatively (Carayannopoulos 2018; Lebeuf et al. 2017).

To address these problems, it is necessary to filter information to avoid information overloads as well as to reduce the workload during daily tasks by providing appropriate assistance. One promising technology for this is the use of artificial intelligence in the form of chatbots. They provide a human-computer interface using natural language-based dialogs and are capable of assisting or automating tasks as well as filtering and providing information (Følstad/Brandtzæg 2017; Schäffner 2017; Schonschek 2017). Although practitioners assume that chatbots can influence employees' productivity positively, the technology itself is still in an early development stage. Even though dialog-based systems (e.g., Amazon's Alexa or Ikea's Anna) are popular among consumers, chatbots are currently not yet widespread in enterprises and corresponding application areas are lacking (Bott 2017; Korenziowski 2017). This is also reflected in the scientific knowledge base, as prior research is limited in this infancy research area. Therefore, we aim at providing an in-depth analysis of the current state of the art as an entry point for future research (Gregor 2006). Based on a structured literature review, we analyze the current literature, describe the outcomes, and postulate open research questions. Thus, we ask the following research questions:

$RQ_1 1$	How can the state of the art of chatbots at the digital workplaces be systematized?
$RQ_1 2$	Which research questions exist in the research area that have not been answered yet?

To answer these questions, the remainder is structured as follows. Next, we present the theoretical foundations in Section 3A1.2 and describe the methodical approach of our literature review in Section 3A1.3. In Section 3A1.4, we outline the results of our literature review, discuss them in Section 3A1.5 and postulate open research questions in Section 3A1.6. We summarize our findings in Section 3A1.7.

1.2 Theoretical Foundations

1.2.1 Digital Workplace

The design of workplaces has a long tradition in human-oriented computer science. In recent years, the nature of work has been changed and affected enterprise technologies as well. New technologies emerged and today's work becomes more digitally. Furthermore, smart systems replaced traditional human capabilities and are used to perform mainly routine tasks (Richter et al. 2018; White 2012). However, information access is still a major problem at the workplace. Thus, new technologies are needed to address this problem in the future (White 2012). As mentioned by RICHTER ET AL. (2018), future application systems have to be user-centric, allow transforming work practices, and must provide flexibility. Therefore, it is necessary for enterprises and especially at workplaces to process information in the appropriate manner to reduce uncertainty and equivocality in daily work. In addition to that, scientific theories also provide insights about how to address these problems. For instance, the media richness theory gives indications how information access should be designed (Daft et al. 1987). To enable research for chatbots at digital workplaces, it is necessary to define the application area in a first step. In general, a digital workplace is not limited to a physical place. Instead, it is a virtual summary of tasks on information, e.g., searching, transforming, documenting (Begau et al. 1993). Nowadays, this is also known as knowledge work (White 2012). Considering today's focus on application systems and messaging services, the digital workplace is usually location-independent, sometimes mobile, and often integrates different technologies, people, and processes (Lestarini et al. 2015; White 2012).

Thus, *a digital workplace combines (IT)-technologies, processes, and people for information processing in and between enterprises. Therefore, the focus lies on working with information and includes a high relevance of communication and collaboration among the involved people and/or application systems.*

Based on this, the following characteristics are noteworthy: First, the primary focus of the digital workplace is the use of information systems for daily tasks and requires an increasing utilization of information for the task fulfillment. In this way, we differentiate it from physical work (e.g., production processes or maintenance tasks, as focused in HOBERT (2018). Therefore, it is firstly necessary to collect or share information that are required for the task execution or to solve (novel) problems. Secondly, employees have to work collaboratively. Therefore, they need systems to support teamwork. Thirdly, employees have to learn continuously for example to adapt to changes in work scenarios. To take these characteristics into account, it is necessary to put human work practices and their context in the center when investigating the potential of digital technologies like chatbots (Richter et al. 2018).

1.2.2 Chatbots

Since the first chatbots *ELIZA* (Weizenbaum 1966) and *ALICE* (Wallace 2009), different approaches for conversational information systems were pursued, but the main characteristics have remained largely the same: A chatbot is a special kind of an application system, whose functions are accessible via a dialog-based user interface, e.g., through messaging services (Lebeuf et al. 2018). It uses artificial intelligence technologies to provide a natural language user interface to various databases or APIs for

the execution of work tasks. Thus, users can communicate – by text or audio – in a natural and intuitive way with application systems (Al-Zubaide/Issa 2011; Angga et al. 2015; Carayannopoulos 2018; Henrich 2017; Mallios/Bourbakis 2016).

Thus, *a chatbot is an application system that provides a natural language user interface for the human-computer integration. It usually uses artificial intelligence and integrates multiple (enterprise) data sources (like databases or applications) to automate tasks or assist users in their (work) activities*.

Additional characteristics of chatbots are: First, chatbots can perform actions *reactively*, *proactively,* as well as *autonomously* based on user inputs or changes in the environment. Second, chatbots are *adaptive* and *capable of self-learning* to handle context information or consider user preferences in future dialogs.

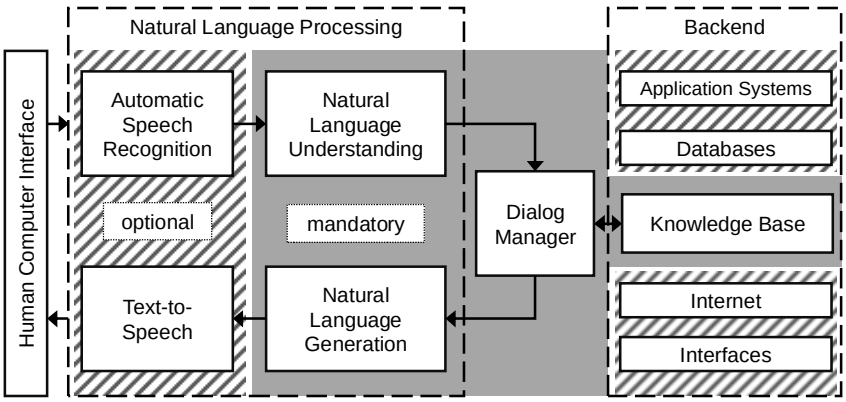


Figure 8 Components of a Chatbot

The technical architecture of a chatbot consists of four mandatory and a few optional modules (Berg 2013; Mallios/Bourbakis 2016) (see Figure 8). As input, voice or text is possible. If voice is chosen, it has to be processed by *automatic speech recognition* to get a machine-readable text. Afterward, the *natural language understanding* analyses the input, dismantles it as well as examines it for patterns. Then the *dialog manager* processes the outcome against the *backend* and inquiries the data or knowledge bases, executes application systems, or calls an API. After processing the user input, the results will be transformed in natural language, e.g., questions or simple answers, via a *natural language generation* module. Finally, the generated text can be outputted as audio by the *text-to-speech* component. For this research study, we focus on the combination of the mentioned components as an entire application system and not on the design of specific technical components. In particular, we analyze the use of chatbots for supporting the daily work of single employees at the digital workplace as described in Section 3A1.2.1. In other words, we understand chatbots as a new medium for human-computer interaction (Følstad/Brandtzæg 2017).

1.3 Methodical Approach

To assess the state of the art and to answer our research questions, we conducted a structured literature review (Cooper 1988; Fettke 2006; Webster/Watson 2002). Therefore, we examined current research approaches, application domains, potentials, and objectives of using chatbots at digital workplaces. According to the aim, we intended to accumulate an almost complete census of relevant literature.

Therefore, we used accessible research results of scientific databases as the basis for our data collection. To perform the search, we used English and equivalent German keywords (Figure 9; see Appendix A2.2-A2.3[8] for a detailed overview of the used search strings). Before including a paper in our literature analysis, we checked the quality of the identified papers as follows: We included only reviewed and published scientific papers to reach a proper level of quality. Additionally, we took into account that papers provide completed research studies with comprehensible results and cite an adequate number of references. In addition to scientific research publications, we added published practice literature that reflects the current state of the art in enterprises. By doing this, we aim at transferring the results from practice in order to harness them in science. The search period was not limited, but we took care that relevant papers comply with the actual state of technology. As we finished the data collection in early 2018, we included literature published until the end of 2017.

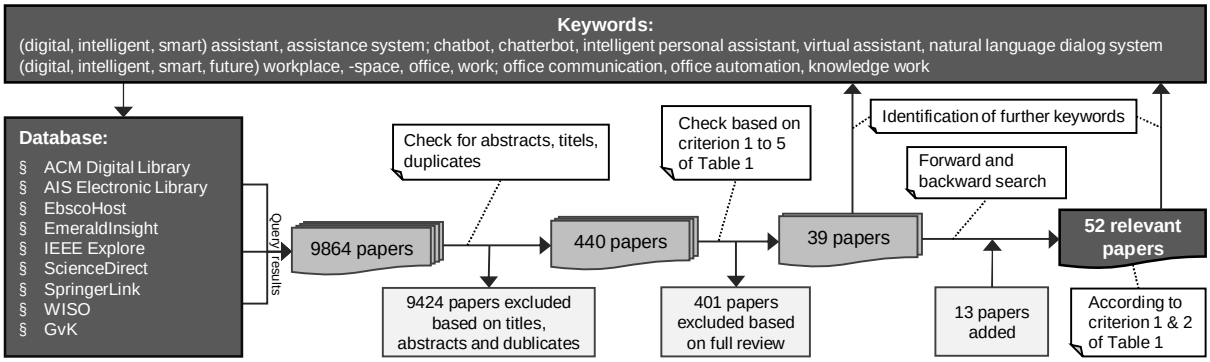


Figure 9 Research Framework of Study I

The found papers were filtered as follows (Gränig et al. 2011): Firstly, we checked the titles and abstracts of all query results and excluded duplicates. Secondly, we reviewed the content of the remaining papers in detail. Therefore, we predefined a list of criteria, based on our research goal, to classify literature as relevant (see Table 10). As shown, only the first two criteria represent relevant literature for our review. We used criteria 3-5 for excluding irrelevant literature.

Criteria	Description
1	Relevant are articles that examine chatbots and application areas at the digital workplace jointly.
2	Relevant are articles that examine chatbots in non-work-related application areas only if the targeted use cases also exist in a comparable way at the digital workplace, e.g., information search tasks or online shopping.
3	Irrelevant are articles that examine chatbots in general but in non-transferable application areas for the digital workplace.
4	Irrelevant are articles that examine digital (office) workplaces without being responsive to chatbots or natural language assistance systems.
5	Irrelevant are articles that examine only technical aspects or single components of chatbots, e.g., mathematical algorithms or interface designs.

Table 10 Criteria of relevant Papers of Study I

After this initial search process, we conducted a forward and backward search and added 13 papers. Overall, we identified 52 relevant research papers, which we analyzed for further study to figure out the contributions, application areas, and objectives of chatbots at digital workplaces (see Figure 9).

[8] In the published version, reference was made to the online appendix at *http://bit.ly/ChatbotsatWorkplaces.*

1.4 Results

In the following, we describe the results of our literature review. First, we present some descriptive findings. Afterward, we outline the research contributions, potentials, as well as objectives of using chatbots at the digital workplace. Due to the extent, we focus on the main contributions of the analyzed papers by summarizing the results briefly. The full overview of the relevant papers, their categorizations, and some descriptive statistical analyses are available in Appendix A2.4 to Appendix A2.7[9].

1.4.1 Descriptive Results

The analysis of our relevance criteria clearly shows that most of the articles correspond to criterion 2 of Table 10 (see Figure 10). Only 9 out of 52 articles examine the application of chatbots at the digital workplace. Due to this limited amount of relevant literature, it is essential to include articles matching criterion 2. Thus, we examine the results of closely related articles that did not mention digital workplaces directly.

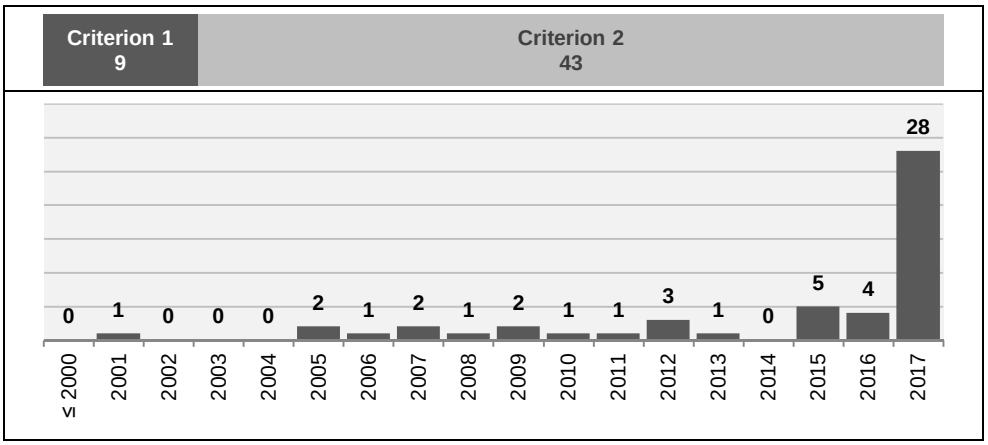


Figure 10 Descriptive Distributions of Study I

The distribution by publication year (see Figure 10) clearly shows the relevance for the topic as already described in the introduction. Considering publications until 2016, we identified only a few relevant papers per year. In 2017, the number of publications increased significantly. In addition, two articles could already be found online-first and were added to 2017.

1.4.2 Application Domains

Our first research goal was to identify and categorize the application domains focused in the actual research. Therefore, we aimed at identifying research contributions belonging to the application domains of chatbots in office work tasks and categorized the articles based on that. This resulted in six categories of application domains at the workplace (see Table 11 and Figure 11) which are further subdivided by the art of the paper (scientific or practice-oriented).

[9] In the published version, reference was made to the online appendix at *http://bit.ly/ChatbotsatWorkplaces.*

Paper		Research Contribution						Potential																		Objective					
		CS	IA	ET	SS	CW	WF	P1	$P1_1$	$P1_2$	$P1_3$	$P1_4$	$P1_5$	$P1_6$	$P1_7$	$P1_8$	P2	$P2_1$	$P2_2$	$P2_3$	$P2_4$	$P2_5$	$P2_6$	P3	O1	O2	O3	O4	O5	O6
Criterion 1	(Bott 2017)	●								●							●			●								●			●
	(Chakrabarti/Luger 2015)	●								●											●								●		
	(Dämon 2017)				●					●										●		●			●						●
	(Gyton/Jeffsry 2017)				●				●	●										●			●			●						●
	(Han 2017)			●				●	●															●	●							●
	(Henrich 2017)				●					●							●	●	●				●			●						●
	(Lebeuf et al. 2017)					●		●															●	●	●	●						
	(Schäffner 2017)						●										●		●						●	●	●	●				●
	(Strehlitz 2017)	●								●									●						●							●
Sum Criterion 2		11	11	2	0	0	19	20	10	8	1	8	5	3	1	1	3	14	3	0	3	6	4	7	40	4	7	6	6	11
Sum Total		14	11	3	3	1	20	43									27							9	47	6	8	8	7	18

Legend:

CS Customer support
IA Information acquisition
ET Education and training
SS Self-service
CW Collaborative work
WF Without focus

P1 Information search tasks
$P1_1$ Request of FAQs
$P1_2$ Answer customer questions
$P1_3$ Answer employee questions
$P1_4$ Searching for products
$P1_5$ Query weather information
$P1_6$ Query traffic information
$P1_7$ Query of tasks and appointments
$P1_8$ Provide maintenance information
P2 Standardized routine processes
$P2_1$ Shopping
$P2_2$ Employee self-service
$P2_3$ Customer self-service
$P2_4$ Banking
$P2_5$ Arrange appointments and meetings
$P2_6$ Setting up reminders
P3 Teaching and learning tasks

O1 Natural language user interface to information systems
O2 Uniformly, device-independent and mobile access to application systems
O3 Increase efficiency and productivity
O4 Decrease of time effort
O5 Reduce of costs
O6 Relieve employees by take over or automate tasks

***Note**: multiple entries present; papers: n=52*

Table 11 Classification of identified relevant Literature

As shown in Figure 11, scientific research focuses mainly on information acquisition. The practice-oriented literature on the other side mostly focuses on customer support. Notably is that we identified a large amount of – scientific as well as practice-oriented – papers without a specific research focus. Just a few authors mentioned the topics self-service, education and training, and especially collaborative work, which are all typical office work tasks. To summarize, we can already detect a literature gap belonging to the use of chatbots for collaboration and digital office work.

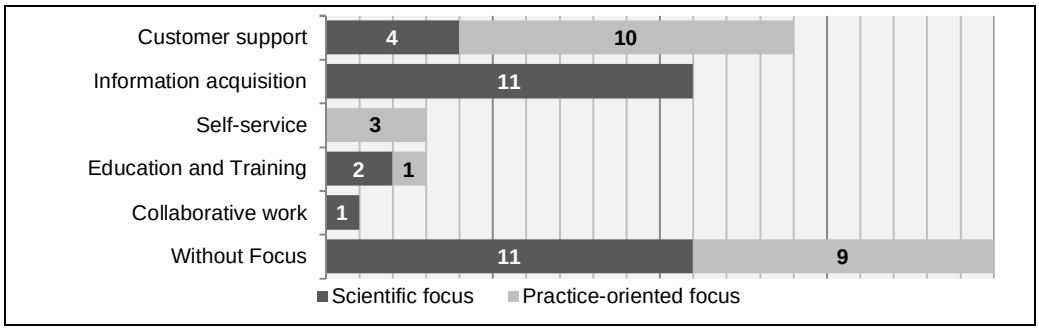


Figure 11 Categorization of Application Domains

Specifically, most of the papers address the field of **customer support** (Chai et al. 2001), e.g., developing a chatbot for the information acquisition for products or services. The findings show that users can get needed information with a lower amount of clicks. AUGELLO ET AL. (2012) describe an ontology-based chatbot for the same area. Based on the ontology, the maintenance effort is reduced. A dynamic approach is followed by CHAKRABARTI/LUGER (2012), and CHAKRABARTI/LUGER (2015). Their chatbot is capable of creating a dynamic goal fulfillment map to answer requests. Evaluations show that

the resulting chatbot is able to handle longer conversations as well as contexts instead of just question-answering. In practice-oriented papers mainly general application scenarios are described, e.g., assistants for customer communication (Aquino 2012), frequently asked question (FAQ) answering (e.g., Korenziowski 2017; Strehlitz 2017), as well as challenges or general conditions of chatbot applications (e.g., Heckel/Ermisch 2017; Masterson 2015). Some papers also address e-commerce (aka conversational commerce) or customer self-services using chatbots, e.g., booking flights or banking (Kuhn 2017; Masterson 2015; Schonschek 2017). Some legal aspects and challenges are described once (Brunotte 2017). Subsuming, we could identify 14 papers with an external enterprise focus on communicating with customers. However, scientific research results are missing and mostly general statements could be derived from practice-oriented papers. Nonetheless, those results can point out evidence for the need for chatbots.

Furthermore, we identified 11 relevant papers belonging to **information acquisition**. Most authors describe various concepts or prototypes – sometimes with evaluation results. In RADLINSKI/CRASWELL (2017) a schema was derived that outlines, which communication patterns exist for information acquisition and how those patterns should be implemented in a chatbot. A general ontology-based chatbot was described by AL-ZUBAIDE/ISSA (2011), which can easily be transferred between different subject areas and thereby reduces maintenance. In CARAYANNOPOULOS (2018), RANOLIYA ET AL. (2017), SHAWAR ET AL. (2005), and SHAWAR (2008) different conceptual approaches were described. In those cases, users can get various information, e.g., upcoming tasks or activities. Also, a chatbot, which uses the Google-search engine as the backend, was identified (Quarteroni/Manandhar 2007). Queries are forwarded to Google and the result is fetched back and displayed in the dialog. Another concept for information acquisition uses a hybrid knowledge base of AIML (for permanent answers) and a database (for frequently changing answers), e.g., customer relationship management (CRM) or enterprise resource planning (ERP) systems (Reshmi/Balakrishnan 2016). In SETIAJI/WIBOWO (2016) a chatbot based on bigrams for similarity calculation and a relational database as data storage is described. Furthermore, in KISELEVA ET AL. (2016), and VTYURINA ET AL. (2017) user satisfaction in search tasks with chatbots was analyzed. Summarizing, concepts or prototypes mostly focus on this application area. However, requirements for this task are lacking as well as detailed evaluations of the resulting chatbots. Thus, detailed insights concerning developed concepts and implementations are also missing. Despite these aspects, this category receives the most attention in the scientific community.

For the field of **self-service**, the authors point out some application areas, like travel expense accounting or chatbots as personal accountants (Dämon 2017; Henrich 2017). Also, chatbots can be used to change the master data of employees as well as retrieve the remaining days off (Gyton/Jeffsry 2017). Overall, the three papers address only abstract and general application areas without going into detail. We declare this by the practice-oriented focus combined with a lacking research method. Therefore, concepts or prototypes are missing and the field of self-service is unexplored. Scientific research is necessary to examine the application area in order to provide insights on how to develop self-service chatbots.

Three articles examine the use of chatbots for **education and training tasks**. For instance, chatbots should support employees' onboarding processes by answering corresponding questions and help

employees to learn company specifics (Han 2017). In addition, lifelong learning at work can be addressed by this as well. Another two relevant papers describe a chatbot (Mikic Fonte et al. 2009a; Mikic Fonte et al. 2009b), which can provide resources for learning via the natural dialog like an automated teaching assistant. In addition, it is possible to evaluate the user based on asked questions. Summing up, only a few contributions exist, which focus mainly on single concepts without outlining requirements or providing evaluation results.

In addition, we could identify only one paper that addresses the **collaborative work** (Lebeuf et al. 2017). The authors explain how chatbots can reduce friction by inappropriate tools in collaborative teamwork settings. They present some realizations, which can be used in communication tools like Slack. Overall, the paper points out the usage potential, but actual research about the use of chatbots for collaborative work is missing.

At last, most of our identified papers are **without focus** on a specific research topic. Papers in this category address multiple aspects, which are described in the following. Some tackle the historical evolution of the technology or relevant components (e.g., Berg 2013; Satu et al. 2015). Furthermore, in practice-oriented papers, various general application areas, challenges, or objectives were described (e.g., Følstad/Brandtzæg 2017; Lebeuf et al. 2018). In addition, three concepts of chatbots without a specified application area are provided. ANGGA ET AL. (2015) present a chatbot with a 3D avatar and facial expressions in addition to the natural language dialog. Also, BANG ET AL. (2015) describe a chatbot that determines matchings based on examples instead of rules. In VAZIRI ET AL. (2017) a chatbot is described, which generates its knowledge base with the help of online available API documentations. After a preprocessing, the documentation is accessible through the dialog. Also, some contributions tackle the adaption of dialogs to enable inquiries when ambiguities occur (Montero/Araki 2005) or to handle the user intention (Neves et al. 2006). At last ZAMORA (2017a), and ZAMORA (2017b) looked at user behavior, perception and expectations. To sum up, all of these papers deliver only sketchy insights in the research area. Nonetheless, they point out some application areas or approaches for using chatbots at digital workplaces, which have to be examined in detail.

1.4.3 Potentials

In addition, we examined actual potentials (P_j) of using chatbots at the digital workplace mentioned in the analyzed literature (see Table 11). As some authors address multiple application potentials of chatbots, it is necessary to record them independently of the research contribution (see Section 3A1.4.2). In doing so, we also tried to gain detailed insights into the application areas as described in Section 3A1.2.1. As seen in Table 11, we identified three potentials. In addition, most of the papers discuss information search tasks in general. The papers of criterion 1 focus mostly on the answering of customer questions. Many of the detailed potentials (e.g., $P1_3$-$P1_8$) were only discussed in the literature of criterion 2 and were therefore transferred by us to the digital workplace.

First of all, chatbots are able to support various kinds of **information search tasks** [P1] to provide users with needed information (e.g., Angga et al. 2015; Reshmi/Balakrishnan 2016). These can be for instance FAQs to relieve employees in the customer service by automating recurring questions (e.g.,

Chakrabarti/Luger 2012; Heckel/Ermisch 2017). Also, general questions, e.g., external questions from customers as well as internal questions from employees, can be answered automatically by chatbots (e.g., Grodzietzki 2017; Setiaji/Wibowo 2016). Furthermore, chatbots provide channels to get product information for purchase preparation (e.g., Berg 2013; Kuhn 2017). In addition, different minor daily information can be retrieved via a chatbot, e.g., upcoming tasks, appointments, or meetings (Panser 2017). Also, it is possible to retrieve information during maintenance processes (Zirn 2017).

Secondly, chatbots are able of mapping **standard routine processes** [P2] (e.g., Schonschek 2017; Zamora 2017a). To do this, they guide employees step-by-step through processes, query necessary entries, and perform corresponding resulting steps (e.g., Henrich 2017; Schäffner 2017), e.g., master data changes or travel expense accounting (e.g., Gyton/Jeffsry 2017; Henrich 2017). Also, employees can use chatbots to arrange meetings in a natural dialog. The chatbot negotiates between the participants and sets up an appointment (e.g., Følstad/Brandtzæg 2017; Korenziowski 2017; Lebeuf et al. 2017).

In addition, as shown in Section 3A1.4.2, chatbots can be used for **teaching and learning tasks** at the digital workplace [P3]. Chatbots can teach learning content in a natural language dialog in such a way that employees can for example demand content for training at the workplace (e.g., Angga et al. 2015; Mikic Fonte et al. 2009a). In addition, employees and their learning progress can be evaluated based on questions. Furthermore, recommendations for further learning steps for employees can be given by chatbots (Augello et al. 2012; Mikic Fonte et al. 2009b).

1.4.4 Objectives

Lastly, we examined the mentioned objectives (O*i*) of using chatbots at digital workplaces (see Table 11). Chatbots provide a **natural language user interface to information systems** [O1]. This allows (enterprise) applications to be easily integrated without the user having to install additional software. The chatbot backend uses existing interfaces to access integrated (enterprise) applications or (web) services and provides them in the same communication channel. This will reduce media discontinuity and application overload within daily work routines (e.g., Bager 2016; Følstad/Brandtzæg 2017; Lebeuf et al. 2017). Instead of learning user interfaces, employees can execute processes or tasks intuitively and with natural language. This will also decrease frustration with existing applications (e.g., Aquino 2012; Carayannopoulos 2018). Additionally, chatbots should provide an **uniformly, device-independent, and mobile access to application systems** through the use of, e.g., messaging services as an interface [O2] (Lebeuf et al. 2018; Schäffner 2017). Furthermore, chatbots are supposed to **increase efficiency and productivity** of work by using speech and providing context information [O3] (e.g., Korenziowski 2017; Zamora 2017a). Also, **decrease of time efforts** [O4] and **reduced costs** [O5] are objectives of using chatbot applications at the digital workplace, e.g., by automatically answering customer questions (e.g., Chakrabarti/Luger 2015; Satu et al. 2015; Zamora 2017a). Lastly, chatbots should **relieve employees by taking over or automating tasks**, e.g., customer service, so that employees can focus on complex or enterprise-relevant tasks [O6]. For tasks that can not be automated completely, chatbots should try to assist employees as much as possible (e.g., Gyton/Jeffsry 2017; Lebeuf et al. 2018; Masterson 2015).

1.5 Discussion of the Results

The results of our structured literature review indicate that research gaps exist in many of the outlined research areas belonging to the actual use of chatbots at digital workplaces. However, as shown in Section 3A1.4.2, we could already identify six research areas targeting the use of chatbots. In the identified scenarios *information acquisition* and *customer support* are mainly addressed. In most papers, authors just describe specific concepts – only a few are evaluated. Office-related topics like *collaborative work*, *education and learning*, or *self-service* are currently only addressed by a few authors who mostly mention only sketchy application areas. Therefore, we conclude that generalized statements for the design of chatbots for the digital workplace are not inferable because requirements, as well as evaluations for the designed approaches, are missing.

Furthermore, we showed that the two main potentials of chatbots are *information search tasks* and *standardized routine processes* (see Section 3A1.4.3). As shown in Section 3A1.4.2, the information acquisition is already examined in some articles, e.g., with concepts or evaluations. For the support of standardized routine processes, only a few limited results are available. In addition, chatbots should provide a natural language interface for enterprise applications, which is not addressed in research yet. Furthermore, many external application scenarios targeting communication with customers are described. In contrast to that, internal application scenarios at the workplace are missing so far. This is also consistent with the identified research contributions, as the focus currently lies on customer support and information gathering, both of which are not purely company or office workplace-related tasks.

In the analysis of objectives (see Section 3A1.4.4), we pointed out that, firstly, chatbots should *integrate enterprise application systems in natural language dialogs*. Secondly, chatbots should *support employees by taking over or automating daily tasks*. Both objectives correspond to the identified application areas. However, not a single paper addresses this fully by describing a concept or a prototype (see Section 3A1.4.2). Thus, we conclude that there is also a research gap.

	Requirements	Concepts	Prototyping	Evaluation	Design Principles	∑ Paper
Customer support	0	**4**	**1**	**3**	0	14
Information acquisition	0	**8**	**7**	**5**	**1**	11
Self-service	0	0	0	0	0	3
Education and Training	0	**1**	**2**	0	0	3
Collaborative work	0	0	0	0	0	1
Without Focus	**1**	**6**	**2**	**5**	0	20
Sum total	1	19	12	13	1	**52**

***Note**: multiple entries present*

Table 12 Contributions to the Design of Chatbots

Furthermore, we analyzed the contributions to the design knowledge base. Since many of the contributions are from practice papers, insights in scientific publications are missing. Therefore, we

analyzed the present design contributions to provide an entry point for future scientific studies. For this purpose, we examined whether the papers provide insights concerning requirements, concepts, artifacts, evaluations, and generalized design principles (Baskerville/Pries-Heje 2010; Gregor/Hevner 2013) (see Table 12). Clearly, we indicate that requirements and generalized results, e.g., design principles, for the design of chatbots at the digital workplace are missing. This is especially surprising as 19 papers describe concepts and 12 papers provide prototypes. However, in order to derive generalized results, it is necessary to identify design patterns for application areas. First, requirements for different application areas have to be identified in order to construct reproducible concepts and prototypes. Finally, it is necessary to evaluate them to derive valid design recommendations.

In addition, we showed in Section 3A1.4 that practice-oriented insights are missing. Even though, we identified some practice-oriented papers, which only address general topics (like customer support). Mainly, the identified empirical research contributions focus on evaluations of the designed chatbots or underlying conditions. Currently, there are no (comprehensive) empirical studies on the use of chatbots at the digital workplace. Therefore, a comprehensive analysis underpinned by practical insights of application areas and their requirements as well as general conditions is required. Especially since chatbots can currently only be used in limited and structured areas of responsibility or work (Al-Zubaide/Issa 2011; Heckel/Ermisch 2017; Schonschek 2017), it is necessary to examine them in detail. We delivered a first approach for this through our structured literature review. Thus, we could show first literature-based results for the topic, but it is still necessary to survey practice-oriented findings in order to investigate and validate them in detail.

1.6 Open Research Questions

Overall, based on our findings and the discussion, we postulate the following open questions (OQ*i*) that should be targeted in future chatbot-related research at digital workplaces (see Table 13). Even though our questions are generally formulated, they can easily be applied to specific use cases. To describe them in detail, we adapt them in the following to the application area of information acquisition (see 3A1.4.2).

		Topics to Address
Behavioral Studies	**OQ1**	*Which application areas are viable for chatbots at the digital workplace?*
	OQ2	*Which prerequisites have to be considered?*
	OQ3	*Which factors inhibit the usage of chatbots?*
	OQ4	*Which factors support the usage of chatbots?*
Design Research	**OQ5**	*How should chatbots be designed?*
	OQ6	*What are the specific requirements?*
	OQ7	*What are the resulting benefits of the usage of chatbots?*
	OQ8	*What are design principles for chatbots?*
	OQ9	*What elements should a theory for chatbots at the workplace include?*

Table 13 Open Research Questions

Firstly, as shown in Section 3A1.4.2 most of the relevant papers focus on information acquisition mainly in the use case of customer support. As stated above, chatbots are currently not widely used at the

workplace and we based our findings therefore on papers matching criterion 2. Therefore, a first question arose, if our application areas are the viable ones or if there are more application areas possible, which are not reflected in the literature currently [**OQ1**]. For the identified application areas, prerequisites must be surveyed [**OQ2**]. Extending this, it is necessary to investigate positive or negative factors [**OQ3-OQ4**], e.g., challenges, opportunities, or objectives, which influence the adoption of chatbots at the workplace. Therefore, research is still necessary for the case of information acquisition in the workplace context, e.g., chatbot access for enterprise (knowledge) databases or internal resources instead of predefined FAQs. Nonetheless, the same questions arose for all other application areas as identified in Section 3A1.4.2, e.g., master data changes or travel expense accounting. Since we scrutinized only the literature belonging to the application areas and objectives, we recommend performing further practice-oriented behavioral studies to answer the open questions, e.g., by interviewing experts or practitioners. In those studies, (potential) users should be surveyed to ascertain the application of chatbots in detail and in real-world scenarios. By answering these questions, theories of explanation and maybe also of prediction can be used (Gregor 2006).

Secondly, as shown in Section 3A1.5, just a few contributions targeting the design of chatbots exist and most of them are concepts or prototypes. However, requirements as a prerequisite for the design of chatbots at the workplace are lacking currently. We suggest addressing the design of chatbots by design research [**OQ5**]. At first, the viable application areas have to be derived and defined, e.g., the mentioned information acquisition. Following this, specific requirements for each application area must be identified [**OQ6**], e.g., necessary database interfaces, organization of data maintenance, security measures, as well as general requirements like input or output modality, and NLP provider. Next, these requirements have to be transformed into (software) artifacts [**OQ5**], e.g., a chatbot for answering employee questions like "*how can I change my password?*" or "*where can I find the documents for travel accounting?*". These artifacts have to be evaluated in further (empirical) studies, e.g., laboratory experiments to gain feedback. The results of the evaluation step can also be used to analyze the impacts of using chatbots in enterprises [**OQ7**]. Finally, all of these results have to be converted into generalized design principles to address the whole design process [**OQ8**]. The results of the individual design research can hereby be adapted to different application areas. For instance, generalized results of an information acquisition chatbot can be used to design a chatbot for internal processes. By answering these further design research questions a theory of design and action can be addressed finally (Gregor 2006). Since currently, no specific theories for chatbots at the workplace are present, the question arose which components theories should have [**OQ9**], e.g., to measure the effects of adaptions or the hindering factors. Existing theories (like the media-richness theory) can be used as a starting point for further theory development.

1.7 Conclusion

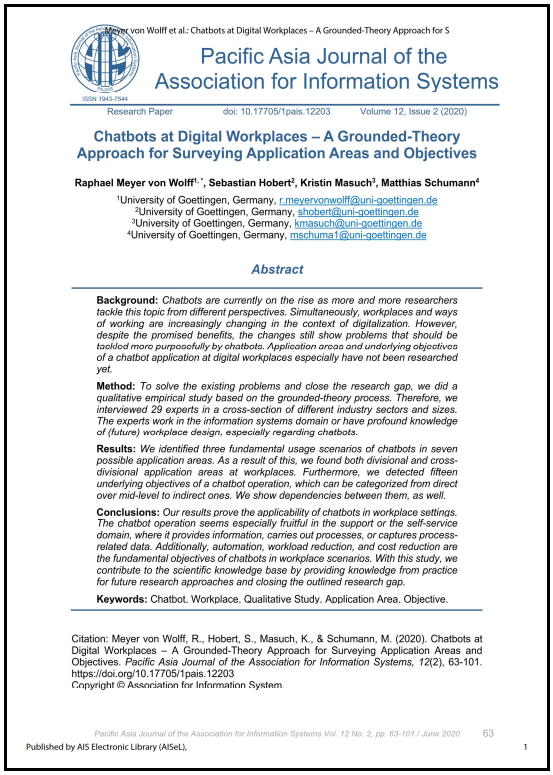
In this paper, we examined the state of the art of chatbots at the digital workplace. Therefore, we asked two research questions and answered them by conducting a structured literature review. As shown, only

a few scientific findings exist that tackle the usage of chatbots at digital workplaces especially for collaborative work between employees.

As in any research study, limitations need to be considered. We evaluated existing scientific and practice-oriented literature until the end of 2017, so there could be newly published papers in the meantime. In addition, we included many articles of closely related topics, which do not mention digital workplaces directly (see Table 10 and Figure 10). Since there are only a few contributions matching criterion 1, we used this approach to survey the state of the art of using chatbots at digital workplaces. Therefore, it is still necessary to gain practice insights in the subject area to validate and extend our findings. To address this, we recommend answering our postulated open questions.

2 State of the Practice on Application Areas and Objectives

Chatbots at Digital Workplaces – A Grounded-Theory Approach for Surveying Application Areas and Objectives



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Chatbots at Digital Workplaces – A Grounded-Theory Approach for Surveying Application Areas and Objectives

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Abstract

Background: *Chatbots are currently on the rise as more and more researchers tackle this topic from different perspectives. Simultaneously, workplaces and ways of working are increasingly changing in the context of digitalization. However, despite the promised benefits, the changes still show problems that should be tackled more purposefully by chatbots. Application areas and underlying objectives of a chatbot application at digital workplaces especially have not been researched yet.*

Method: *To solve the existing problems and close the research gap, we did a qualitative empirical study based on the grounded-theory process. Therefore, we interviewed 29 experts in a cross-section of different industry sectors and sizes. The experts work in the information systems domain or have profound knowledge of (future) workplace design, especially regarding chatbots.*

Results: *We identified three fundamental usage scenarios of chatbots in seven possible application areas. As a result of this, we found both divisional and cross-divisional application areas at workplaces. Furthermore, we detected fifteen underlying objectives of a chatbot operation, which can be categorized from direct over mid-level to indirect ones. We show dependencies between them, as well.*

Conclusions: *Our results prove the applicability of chatbots in workplace settings. The chatbot operation seems especially fruitful in the support or the self-service domain, where it provides information, carries out processes, or captures process-related data. Additionally, automation, workload reduction, and cost reduction are the fundamental objectives of chatbots in workplace scenarios. With this study, we contribute to the scientific knowledge base by providing knowledge from practice for future research approaches and closing the outlined research gap.*

Keywords: Chatbot. Workplace. Qualitative Study. Application Area. Objective.

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2.1 Introduction

In recent years, a new trend for supporting employees in daily work scenarios emerged: the application of chatbots, i.e., artificial intelligence and natural language-based human-computer interfaces (Følstad/Brandtzæg 2017; Reshmi/Balakrishnan 2016). Even though the technology has been around for a long time, new technological advances are giving it a new rise (Dale 2016). Additionally, as with the current progressing digitalization of established working practices and the redesign of the workplace, employees, and the way they work are concerned. More innovative and private-known digital technologies are used to enhance the working quality (Byström et al. 2017; Köffer 2015; Lestarini et al. 2015; White 2012). Despite these advantages, the increasing use of information systems and necessary information sources leads to information and application overload. Regardless of the spread of new and smart systems, information access is still a major problem at workplaces as employees sometimes cannot find the information they need or do not know what to look for. Thus, it takes longer to search, edit, and share information negatively affecting productivity instead of improving it (Carayannopoulos 2018; Lebeuf et al. 2017; Russell 2012; White 2012). Therefore, nowadays user-centric information systems, like chatbots or conversational agents, are been applied as a new and intuitive form of human-computer interface. Chatbots automate tasks, filter necessary information for work execution, or assist in the daily work tasks. Thus, employees can carry out their work and reach their respective goals without much training due to a natural communication regardless of specific phrases (Følstad/Brandtzæg 2017; Reshmi/Balakrishnan 2016; Richter et al. 2018). However, besides the currently common application of chatbots in customer service or employee support scenarios, the scientific knowledge base is, to the best of our knowledge, still limited. In particular, the use of chatbots at the workplace to support daily tasks is barely considered. Prior studies focus mostly on general information acquisition as an application area (e.g., Carayannopoulos 2018; Reshmi/Balakrishnan 2016), or general design aspects like gender and response behavior (e.g., Feine et al. 2019a; Go/Sundar 2019). Additionally, the studies often only focus on particular use cases and design corresponding chatbots without regarding underlying requirements in detail. However, this current research is not related on the professional workplace and would have to be transferred in the first place, if at all.

This is especially important since in professional working environments deviating requirements on the technology exist, e.g., data security, business-critical transactions, or the already stated information and application overload. However, business applications are dependent on decisions by the management and mostly driven by economic aspects. Thus, only if the use case is viable, a chatbot operation is performed. Additionally, the more natural language interfaces receive attention in private life and are used for different tasks, the more employees demand to integrate them into their daily work. Even if companies are increasingly turning to this consumerization, it is not easy to introduce systems that are available on the market (Koch et al. 2014). On the one hand, functions are sometimes provided that are not relevant in everyday business. On the other hand, the systems must be able to be integrated with company systems in order to be able to carry out business processes. This also leads to integration problems and data security and safety concerns. Thus, in business contexts, it makes more sense to

design own systems based on the respective requirements. Notably, not necessarily all private-known application areas of chatbots lead to advantages but can be used as a starting point. Additionally, the current private application areas of chatbots cover many areas of daily life or entertainment, such as organization and smart home control. For transferring the technology of chatbots to workplaces, however, it must be surveyed whether these scenarios also exist in the company in order to be able to build on existing results and not to include systems whose functionalities do not address the tasks of everyday office life. Thus, it is necessary to survey the application areas as well as connected objectives. As shown, the viable application areas, besides information acquisition, are either unclear or the technology is only suitable for the areas of knowledge examined. Thus, as chatbots should support employees in the daily work, where further tasks and requirements arise, the current scientific knowledge cannot guide in decision-making processes, when planning to integrate chatbots in the workplace. Hence, it is necessary to identify established or potential application areas within the practice in order to make realistic and practical problems as well as knowledge available for science. Additionally, as requirements are lacking, corresponding requirements in these application areas should also be examined. Otherwise, a chatbot could not be developed appropriately, or requirements are not implemented. A further essential factor in the application of chatbots in a professional working environment are the related objectives. As decisions in a business context are often made on possible achievements, a guideline for this is necessary. This allows decisions to be taken if the intended objectives could be achieved. However, although application areas and objectives are critical issues in the professional working context, this is currently not properly addressed in the scientific knowledge base (Meyer von Wolff et al. 2019a). Hence, open research questions exist, which must be answered to survey the application of chatbots in workplace settings comprehensively.

Thus, the aim of the contribution is to create a basis for chatbot development in digital workplace contexts. For this purpose, it is important to identify meaningful areas of application and to point out related objectives. These results are to be shown in general for digital workplaces independent of an industry so that design research studies can be based on them in order to obtain generalizable results as a foundation for subsequent chatbot development processes at the professional digital workplace. Thus, we survey application areas and related objectives, which can be used in different workplace settings as a foundation for subsequent studies. Therefore, we have oriented ourselves on the research agenda of MEYER VON WOLFF ET AL. (2019a) and used this as a starting point for the following research. Consequently, we did an empirical cross-section interview study among practitioners and experts of German companies. In doing so, we want to survey the application of chatbots in a professional working environment, and to enable a transfer from the already established consumer-oriented applications. Thus, we focus also on the organizational level, as the introduction of technologies in professional working environments is mainly based on organizational decisions instead of being based on individual ones. To address the current situation in the scientific knowledge base, we survey tasks performed by chatbots and viable application areas at digital workplaces. The results are based on a paper presented at the *25th Americas Conference on Information Systems* (Meyer von Wolff et al. 2019b). To further contribute to the scientific community, we extend the results with additional insights into the underlying objectives of chatbot systems, or rather their application, and an extended discussion of the results. Hence, based on the open research questions described in MEYER VON WOLFF ET AL. (2019a), and the

underlying necessity to examine application areas, their relevant tasks as well as underlying objectives, we address the following three research questions in this research article:

$RQ_2 1$	Which usage scenarios can be performed by chatbots at the digital workplace?
$RQ_2 2$	What are the possible application areas for chatbots at digital workplaces?
$RQ_2 3$	What are the objectives of a chatbot application at digital workplaces?

To answer these questions, the remainder of the article is structured as follows. Next, we point out the theoretical background of the paper: chatbots and digital workplaces, as well as the related research. After that, we will describe our research design of the empirical study. Following, we will present the tasks and application areas of chatbots at digital workplaces. Next, we describe (underlying) objectives of the application of chatbots as well as dependencies among them. Afterward, we will discuss our findings. We conclude our article by highlighting limitations and implications and briefly summarizing the research results.

2.2 Theoretical Background

In this chapter, we describe the theoretical background. Firstly, we describe chatbots and their underlying technical concepts. Secondly, we briefly define the concept of digital workplaces. Thirdly, we point out the current state of chatbot research to outline the relevance of the topic.

2.2.1 Chatbots at Digital Workplaces

Chatbots are a special kind of information system that uses artificial intelligence technologies to provide a natural language user interface. Since the first applications of conversational information systems, e.g., *ELIZA* (Weizenbaum 1966) or *ALICE* (Wallace 2009), different approaches were pursued. Independent of the technological advancements of the last years and the use of different synonyms, e.g., chatbot, chatterbot, conversational agent, or digital agent, the main characteristics have not changed (Dale 2016). By using text or audio, the user can communicate naturally and intuitively via a dialog-based interface with the information system (Lebeuf et al. 2018). Therefore, a chatbot allows access to various knowledge bases or via application programming interfaces (APIs) to other information systems or (web) services (Al-Zubaide/Issa 2011; Angga et al. 2015; Carayannopoulos 2018; Mallios/Bourbakis 2016). In addition, a chatbot can perform its actions reactively and proactively as well as autonomously based on environmental conditions. Also, a chatbot is, to a certain extent, adaptive and capable of (self) learning.

Nowadays, chatbots are being applied in different domains, e.g., customer support, home automation, education, or digital professional workplaces. However, the latter is often used nowadays but not defined commonly. Therefore, to enable research studies for chatbots at workplaces, it is necessary to define the concept of a digital workplace beforehand. The design of workplaces already has a long tradition in human-oriented computer science (Richter et al. 2018). A digital workplace is not limited to a physical location. Instead, it is a combination of work duties, information-related tasks, e.g., searching,

transforming, or documenting, and the required information systems. It is, thus, location-independent and sometimes mobile. The mentioned information-centric work is nowadays, also referred to as knowledge work (Lestarini et al. 2015; White 2012). Thus, we target, or rather examine, the information-heavy tasks, e.g., professional business and support processes, and not the production processes (Rüegg-Stürm 2005).

In terms of the technical perspective, chatbots usually consist of three essential components, which are used via a *human-computer interface* (see Figure 12) (Berg 2014; Mallios/Bourbakis 2016). In the *natural language processing* component, the user input is transformed into a machine-readable form. In doing so, the text is analyzed, dismantled, and patterns are extracted. Also, the natural language processing generates a natural language output (e.g., audio or text) based on the results of the dialog manager. The *dialog manager* is responsible for the matching of the user input with the backend, by extracting content or executing functions. The *backend* consists of databases, information systems, or APIs. In this research, we focus on tasks and application areas of chatbots independently of a specific component design.

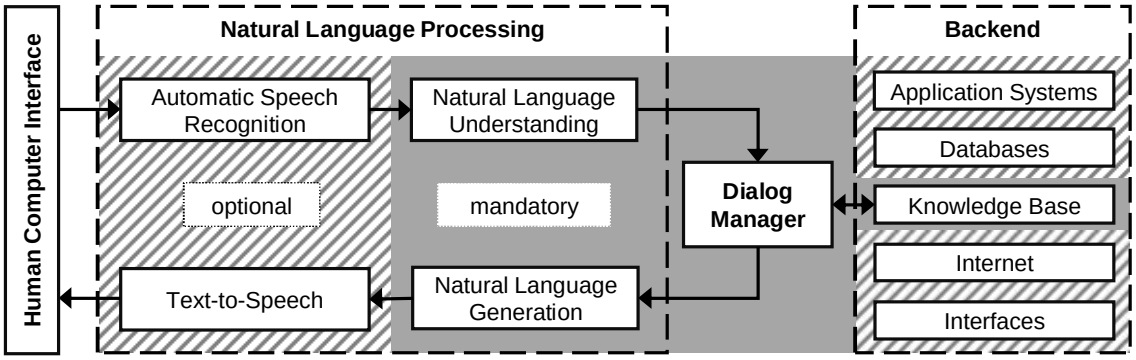


Figure 12 Chatbot's Architecture

2.2.2 Related Research

For several years, chatbot research has been on the rise as many researchers address the topic from different perspectives. As mentioned, first instantiations were pursued years ago by WEIZENBAUM (1966) and WALLACE (2009). Since these early prototypes, different approaches have been undertaken that focus mainly on the application areas by design research or through some kind of meta- or application area-independent research.

For the first group, the current research focuses mostly on various **chatbot instantiations** for the domains customer support, information provision, education and training, or digital workplace, as already shown in MEYER VON WOLFF ET AL. (2019a). A selection of some relevant contributions is shown in Table 14. In the area of customer support, the current research addresses topics on how to enhance the chatbot usage for the customer. In doing so, researchers show that in general, the finding of solutions is accelerated. Also, longer interactions are possible, if a comprehensive mapping of the possible question paths is available. This can also contribute to better context processing. However, most chatbot providers offer extensive tools for customer support to create appropriate chatbots. Additionally, information acquisition is mostly a topic of interest in design research. In doing this, the researchers try to analyze communication patterns, which should be implemented to enhance the tasks. Also, many

researchers focus on specific instantiations for information acquisition, which differ in the objectives: information acquisition in general or from workplace software. Due to the generalizable characteristics of this research, these results are most likely to be reused for the digital workplace. A further application area that receives attention currently is the education domain. Besides some state of the art analyses, the researchers apply chatbots in educator-learner interaction. In doing this, chatbots should provide individualized and adaptive learning content, or answer questions of the learner. Also, some of them already point out design recommendations for chatbot artifacts. However, even if the higher education, as studied in prior studies in the higher-education domain, does not correspond directly to digital workplace tasks, education is also relevant in today's work. Thus, in general, the results could be transferred if this is an intended task. Lastly, some research is conducted in the area of the digital workplace. It is surveyed how chatbots can contribute to group settings, e.g., reducing friction or improving performance. In addition, some research studies tackle the ideation, or rather the design thinking, which is often used in today's businesses. Therefore, studies are conducted to survey how chatbots can be used to support the idea generation, where the chatbot is a mean to contribute ideas to an idea platform or a moderator for a design thinking process. Thus, relevant workplace tasks, or (business) processes are currently not surveyed by the community.

Domain	Contribution to chatbot research	Exemplary references
Customer support	Faster information provision through natural interaction	(Chai et al. 2001)
	Goal fulfillment map-based chatbot for longer and dynamical interactions	(Chakrabarti/Luger 2015)
	Overview of functionalities of chatbot providers to enhance the customer interaction	(Johannsen et al. 2018)
Information acquisition	Communication patterns for information acquisition with chatbots	(Radlinski/Craswell 2017)
	Concept for an ontology-based chatbot	(Al-Zubaide/Issa 2011)
	Chatbot instantiations for information acquisition	(Carayannopoulos 2018), (Ranoliya et al. 2017)
	Workplace-related information acquisition with chatbots, e.g., ERM or CRM	(Reshmi/Balakrishnan 2016)
Education	Literature review for chatbot potentials in education	(Winkler/Söllner 2018), (Hobert/Meyer von Wolff 2019)
	Development of intelligent tutoring or learning systems; with partly design recommendations	(Mikic Fonte et al. 2009b), (Hobert 2019b), (Vladova et al. 2019), (Winkler et al. 2020a)
	Conceptualized architecture for higher education chatbots	(Sjöström et al. 2018)
Digital Workplace	Reduce friction in collaborative teamwork with chatbots	(Gyton/Jeffsry 2017)
	Improvement of group performance in problem-solving scenarios with chatbots	(Winkler et al. 2019)
	Ideation and design thinking with chatbots; with partly design recommendations	(Bittner et al. 2019), (Tavanapour/Bittner 2018), (Tavanapour et al. 2019), (Strohmann et al. 2018)
	Chatbots as a mean for feedback exchange	(Lechler et al. 2019)

Table 14 Current Chatbot Instantiations in Scientific Research

Instead of investigating individual application areas, some researchers try to examine the **application of chatbots** in general. For instance, STOECKLI ET AL. (2018) show functional affordances of chatbots, e.g., receiving notifications, updates, or information, and how a chatbot can provide value. In doing this, they also point out the usage settings of chatbots. However, they conducted a study with mostly Swiss participants. A similar approach was made by LEE ET AL. (2019), who conducted a requirements analysis

for the application of chatbots for career advising. Also, in LAUMER ET AL. (2019b), use cases of conversational agents were pointed out, e.g., information retrieval or work & office. Nevertheless, they did not focus on the digital workplace directly, and, additionally, some private areas of use are also listed, e.g., smart home control, goods & services, or music entertainment. Furthermore, GNEWUCH ET AL. (2017) try to summarize the application of chatbots in customer service by showing generalizable design recommendations. The most similar research was conducted by FENG/BUXMANN (2020), who also identified areas of application for conversational agents for workers. However, this research was based only on the literature without taking into account opinions from practice. Furthermore, some research focus on the user experience or the motivation to use chatbots (Følstad/Skjuve 2019), or the perceptions of the user when applying chatbots (Wuenderlich/Paluch 2017). In addition, the aims and intended effects of a chatbot application were surveyed (Rzepka 2019). Fundamental, e.g., efficiency, ease of use, convenience, and means objectives, e.g., hands-free and eyes-free use, naturalness of conversation, ensure trust, are described. Also, STIEGLITZ ET AL. (2018) propose a research model to examine factors influencing the intention to use an enterprise chatbot, like trust, efficacy, and so on.

Besides the research that focuses on application areas and instantiations, some researchers survey **design features** of a human-like chatbot or **influences** of chatbot applications. For instance, GO/SUNDAR (2019) survey aspects for humanizing chatbots, e.g., anthropomorphic visual cues or high levels of contingent message exchanges. In addition, LIEBRECHT/VAN HOOIJDONK (2020) also examine human response behavior as a requirement for creating more human-like chatbots. Also, the impacts of anthropomorphic and functional features on the acceptance of chatbots, which are implemented in enterprise application systems, are surveyed (Rietz et al. 2019). The results show a high impact of anthropomorphic design features on perceived usefulness. A similar approach can be found in MONTERO/ARAKI (2005), who enhance the dialog through human-like characteristics based on the observed behavior of the structure of a human chat. Similarities and differences between human-chatbot and human-computer interaction were elaborated (Nguyen/Sidorova 2018) as well. In SCHUETZLER ET AL. (2018), the influence of chatbots' conversational relevance on the perception of humanity and engagement is surveyed. The results show that conversational agents, who give conversationally relevant responses, are perceived as more human-like and socially, which is quite obvious and should be intended. To extend this, in a recent study by GNEWUCH ET AL. (2018), the influence of artificial response delays in the chatbot dialog was examined. They show that in particular dynamic delays have the highest influence, and should be used in chatbot systems. Also, the influence of different features, e.g., high vs. low message interactivity or platform self-disclosure, for the case of onboarding was surveyed (Adam/Klumpe 2019). Furthermore, some researchers investigate gender aspects of chatbots (Feine et al. 2020b). Based on their results, they hint at which circumstances a specific gender should be applied. In another publication (Feine et al. 2019a), a survey was done on the conversation between humans and chatbots by conducting a structured literature review and deriving a taxonomy of social cues in conversational agents. The effects of gender, as well as the user's subjective knowledge, are also investigated by PFEUFFER ET AL. (2019), who show that female agents and stereotypical female traits increase the user's perceived competence of the chatbot. Especially trust factors are a topic in chatbot research as well. SEEGER ET AL. (2017) survey this by identifying factors to enhance and support trust in a theoretical model based on hypotheses. Additionally, trust aspects when applying chatbots in

healthcare contexts are examined. In doing this, also a first theory of trust was developed (Wang/Siau 2018). A last identified contribution tackles trust in the case of assistive robots at the workplace (Stock et al. 2019). The authors developed a model to measure these trust aspects. However, they focus on robots and not on conversational agents, as described in this research, the results can be transferred, as both technologies are based on artificial intelligence and natural language processing. As all of this is a kind of meta-level research, or rather, application area independent research, the corresponding findings should be used for a specific chatbot implementation.

Lastly, a few researchers try to summarize current findings of the scientific knowledge base in **(literature) reviews**, which can help by finding open research topics and relevant papers for future research. The current state of the art on chatbot or conversational agent research was summarized by DIEDERICH ET AL. (2019b) and MEYER VON WOLFF ET AL. (2019a). MAEDCHE ET AL. (2019) addressed this by highlighting application areas, opportunities, and future settings, which was also done by SEEBER ET AL. (2019). Furthermore, all four papers point out future research perspectives and open questions. A different approach was done by RZEPKA/BERGER (2018), who review the user interaction with AI-enabled systems. Lastly, FØLSTAD/BRANDTZÆG (2017) try to summarize the chatbot topic on a practical level, with highlighting implications and opportunities for the human-computer interaction with this new application system as well.

Thus, when summarizing the current research, we identified a focus on design research for the application areas of information acquisition and customer service. However, fewer researchers address the application of chatbots in professional workplace contexts, which is necessary to provide a basis for design research and successful chatbot projects in practice. Instead, often chatbots have been developed for specific general applications without focusing on professional digital work, and, thus, these guidelines are missing. Nevertheless, in principle, it can be assumed that results from previous or general studies are transferable. For this purpose, however, it should first be checked which application areas at the workplace are suitable in order to transfer results from research dealing with these areas in other contexts. It is also necessary to check whether all research areas are relevant and transferable – the information acquisition or customer support is most likely to be transferable (Stoeckli et al. 2018) – or whether individual areas are not necessary for the workplace, e.g., smart home control (Laumer et al. 2019b). Nonetheless, the current research perspectives and their application areas can be used as an indicator of possible application areas for workplace use, and thus, they should be transferred. This is especially important for a variety of design recommendations or features, as discovered in the application-independent research. These results should necessarily be taken into account when implementing specific chatbots, as they are a kind of meta-requirements or general design guidelines. Nonetheless, the suitability of each feature should be verified for each target application area at the digital workplace. However, the current research gap starts earlier: finding the possible use cases; because, as mentioned before, there is currently no research on this for the professional workplace context. Hence, in a first step, possible application areas should be derived and examined beforehand, which was already done by a few researchers, even if not for the digital workplace. In addition, current research does not yet comprehensively show any objectives or effects that should be achieved with a chatbot operation. Thus, on an organizational level, practitioners do not have an overview of possible

application scenarios and objectives of chatbots in workplace settings, which can lead to wrong decisions. Additionally, for scientific research, application areas and objectives are necessary when designing and implementing chatbots, as well as when deriving theories for the application of chatbots in the digital workplace. Nonetheless, many studies exist that address single or a selection of necessary issues, whose results should be taken into account and transferred to future studies. However, without a comprehensive overview, the risk remains that individual and essential aspects are not considered. Thus, summarizing the current research, we could derive a lack of research on application areas of chatbots at professional digital workplaces, as well as on underlying objectives. Thus, building on former studies of FØLSTAD/BRANDTZÆG (2017), MAEDCHE ET AL. (2019), MEYER VON WOLFF ET AL. (2019a), SEEBER ET AL. (2019), and STOECKLI ET AL. (2018), we conduct a practice-oriented expert study to address the current situation in the scientific knowledgebase. The results of which are outlined in the following sections.

2.3 Research Design

To identify the usage scenarios ($RQ_2 1$), application areas ($RQ_2 2$) as well as underlying objectives ($RQ_2 3$) of chatbots at digital workplaces, we conducted a qualitative empirical interview study based on DÖRING/BORTZ (2016) and MYERS (2013). As described in WIESCHE ET AL. (2017), we followed the *Grounded-Theory* process to obtain a description of possible chatbot tasks, application areas, as well as underlying objectives. In order to conduct the study, we applied several *Grounded-Theory* procedures to survey the research area explorative under consideration of the situational conditions of expert interviews (see Table 15).

Contribution	Theory		Model		**Rich description**
Procedures	Theoretical sampling	**Role of prior theory**		**Open coding**	Memoing
	Axial coding	**Selective/Theoretical Coding**		**Constant comparison**	Coding paradigm/families

Table 15 Categorization of Research Design

We followed a three-step process for our study: First, we selected potential interview partners based on personal contacts from projects or fairs and an internet search. Therefore, we interviewed experts who deal with current topics and trends of digitalization, particularly chatbots or natural language user interfaces. To ensure quality, every expert in our interview study had at least a few months of working practice in the workplace design. In addition, the experts should work either in companies, which plan or already use chatbots, or in software firms, which develop chatbots for workplaces. Thus, this sample group is capable of:

(1) assessing the influence of the technology, and evaluating how chatbots may redesign the digital workplace of the future;
(2) having knowledge about current or future applications areas of chatbots at the digital workplace.

To ensure heterogeneity and achieve a comprehensive cross-section for the research domain, we include experts independently of the industry sector. Hence, we want to achieve results that can be applied in general workplace settings and are not biased for a specific industry or work environment.

We contacted the identified potential experts by e-mail and sent them a leaflet about our research project. Overall, 29 out of 68 contacted experts have agreed to participate in the study (43 %; see Table 16). The high participation rate already pointed out the relevance of the research area and the enterprises' interest. The participants' group consists almost entirely of German experts.

ID		Position	Industry
INT01	EXP01	Project Leader	Information & Communication Technology
INT02	EXP02	CEO	Information & Communication Technology
INT03	EXP03	Product Owner	Automotive Engineering
INT04	EXP04	Subject Specialist	Automotive Engineering
INT05	EXP05	Online Editor / Consultant	Information & Communication Technology
INT06	EXP06	Senior Manager	Other services
INT07	EXP07	Head of Department	Finance & Insurance
INT08	EXP08	Team Leader / Consultant	Information & Communication Technology
INT09	EXP09	Consultant	Finance & Insurance
INT10	EXP10	Digital Engineer	Finance & Insurance
INT11	EXP11	CEO	Information & Communication Technology
INT12	EXP12	Leading AI-Architect	Information & Communication Technology
INT13	EXP13	IT Service Manager	Chemicals, Pharmaceuticals & Raw Materials
	EXP14	IT Service Manager	Chemicals, Pharmaceuticals & Raw Materials
INT14	EXP15	Lead IT Architect	Chemicals, Pharmaceuticals & Raw Materials
INT15	EXP16	CEO	Information & Communication Technology
INT16	EXP17	Head of Controlling & ICT	Other manufacturing
INT17	EXP18	Major Account Executive CE	Other services
INT18	EXP19	Director Information Management	Finance & Insurance
INT19	EXP20	Divisional Management	Other services
INT20	EXP21	Business Development Manager	Information & Communication Technology
INT21	EXP22	Executive Board	Information & Communication Technology
INT22	EXP23	CEO	Information & Communication Technology
INT23	EXP24	Expert Sales Manager	Information & Communication Technology
INT24	EXP25	Account Manager	Information & Communication Technology
	EXP26	Senior Consultant	Information & Communication Technology
INT25	EXP27	Technology Manager	Other services
INT26	EXP28	Head of Workplace Services	Information & Communication Technology
INT27	EXP29	Project Manager / Service Developer	Finance & Insurance

Note: *Interview* (INT*i*), *Expert* (EXP*i*)

Table 16 Description of the Experts participated in Study II

Second, prior to the interviews, we sent the experts a pre-questionnaire[10], along with an information sheet for the introduction of the relevant terms (i.e., chatbot and digital workplace) as well as a privacy policy. The introduction in the relevant terms should clarify our research project and the relevant foundations to allow a common understanding of the topic. In the following, we conducted the interviews face-to-face or via phone from July to October 2018. These lasted from 31 to 94 minutes (*mean*=54:07 min.; *median*=51:50 min.). To leave the interviewees enough room to express their own

[10] See Appendix A3.1 for the applied pre-questionnaire.

ideas, we used a semi-structured interview guideline to conduct the interviews[11]. Therefore, we used the following leading questions as a basic structure (see Table 17). We stopped the survey when no new insights were revealed in the last interviews according to the theoretical saturation by GLASER/STRAUSS (2006). If the privacy policy was accepted, the interviews were recorded on tape and afterward transcribed. Otherwise, we used intensive note-taking to document the results.

Use cases	§ Do you use or plan to use chatbots in your company? § For which tasks or application areas are chatbots applied? § Which tasks are supported by a chatbot? § What are the characteristics of a chatbot task? § For which scenarios can a chatbot not be used? § What are the potential future application scenarios?
Underlying objectives	§ What are the objectives of the chatbot operation? § What outcomes have been achieved?

Table 17 Leading Questions of the Interview Guideline of Study II

Third, we analyzed and coded our transcripts by using a structured content analysis approach. To obtain more detailed insights into the application areas of chatbots at digital workplaces, we have done our coding and analysis in three steps, followed by a subsequent categorization. First, we analyzed the mentioned tasks performed by chatbots to determine the necessary functions ($RQ_2 1$). Second, we looked for the mentioned application areas related to chatbots. Additionally, we assigned the aforementioned tasks to the identified application areas to map the needed functional scope ($RQ_2 2$). Third, we collected mentions for underlying objectives in the transcripts ($RQ_2 3$). The identified objectives were mapped to the corresponding target category lastly. The coding was done by two researchers independently using continuous analysis of the transcripts, followed by an assignment of the codes to the core topics (Mayring 2014). Since the survey and analysis were conducted in German, we translated the final coding into English while preserving the meaning. The corresponding results are outlined in the following.

2.4 Results

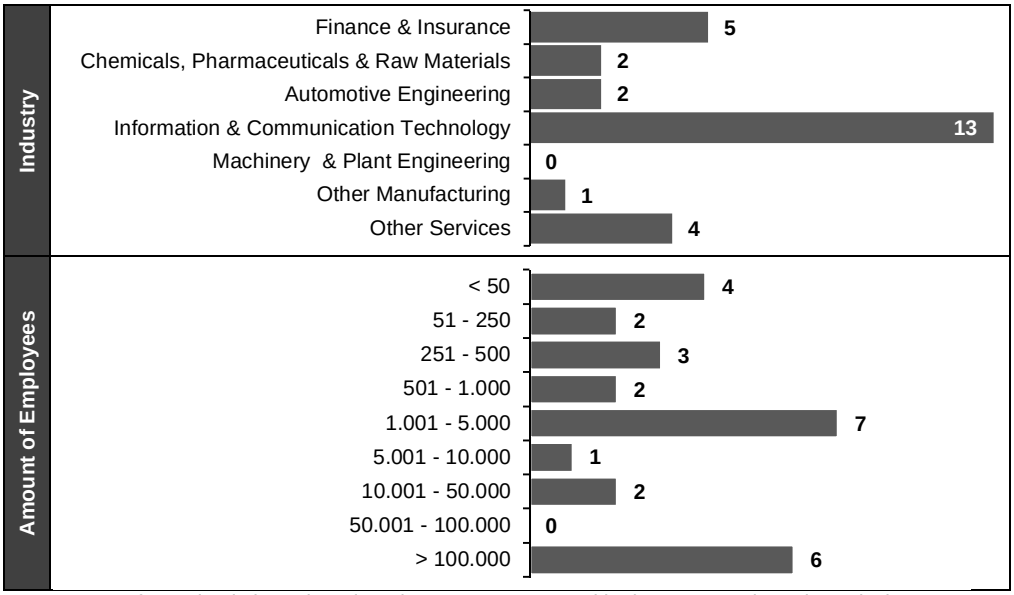
In the following, we show our results of the qualitative interview study. We describe our sample first. Secondly, we present the derived chatbot tasks and, subsequently, the possible application areas at digital workplaces along with a brief assessment of the deployment scenario. Lastly, we point out the purposed objectives of a chatbot operation.

2.4.1 Sample Description

Our sample consists of a cross-section of different industries (see Figure 13). The interviewed experts mostly work in the information & communication sector (approx. 48 %) followed by finance & insurance (approx. 19 %), and other services (approx. 15 %). The information and communication industry seems

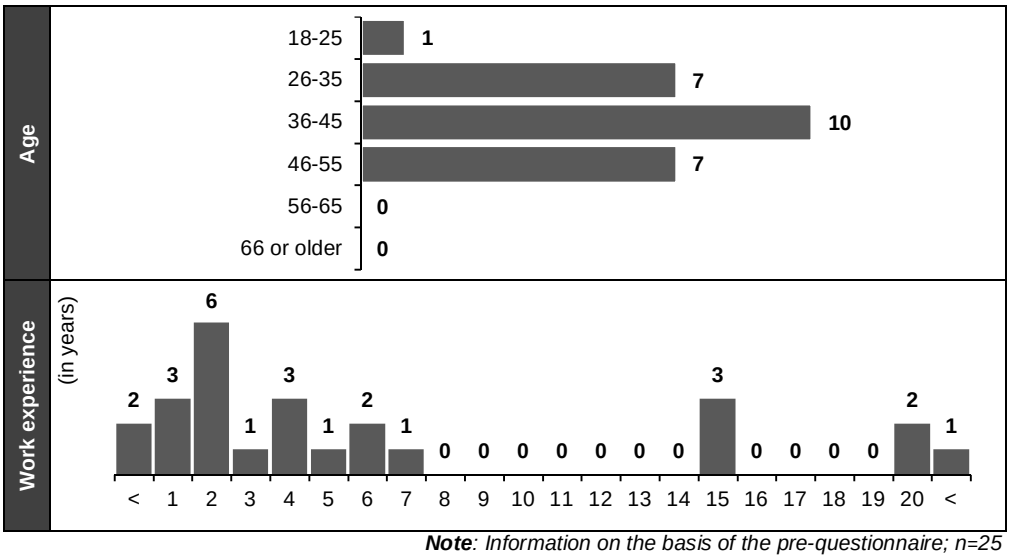
[11] See Appendix A3.2 for the complete semi-structured interview guideline of the overarching empirical interview study.

overrepresented in our sample. This might be explained as experts from outsourced IT-departments or (exclusive) IT-business partners, e.g., for insurance or automotive, are contacted as well. Furthermore, chatbots or their application is an information technology-driven initiative, which can also explain the distribution. Additionally, experts from many different company sizes, measured in the number of employees, participated (see Figure 13). Mostly medium-sized with 1.001 to 5.000 employees (approx. 26 %), followed by very large companies (approx. 22 %), and companies with less than 50 employees (approx. 15 %) participated in our study. As with the industry sector, we could acquire a cross-section of different company sizes.



***Notes**: Information is based on data the experts answered in the pre-questionnaire. Missing company data was researched and added manually in October 2018; n=27*

Figure 13 Sample Characteristics of the Companies in Study II



***Note**: Information on the basis of the pre-questionnaire; n=25*

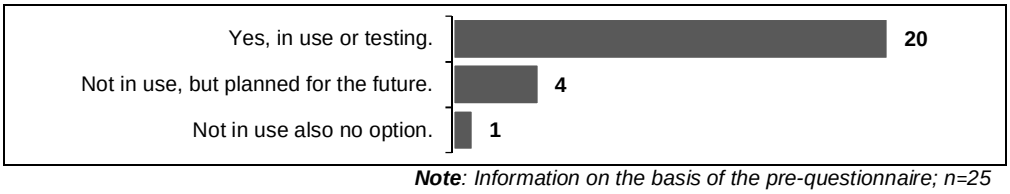
Figure 14 Sample Characteristics of the Participants in Study II

The experts' age is nearly distributed normally (see Figure 14).[12] Mostly, the participants are between 36 and 45 years old (40 %), followed by 26-35 and 56-55 years (35 %). Most participants already have

[12] In the published version, this paragraph is missing and was added for completeness.

at least 2 years of professional experience. However, six participants have even more than 15 years of experience (24 %), and only five have less than 2 years of experience (20 %). Thus, we could acquire a wide range of actual work experiences, which will help us to achieve a comprehensive overview of chatbot applications and underlying objectives.

As part of the pre-questionnaire, we prompted the current state of the chatbot application (see Figure 15). As shown, most of the participating companies already operate chatbots for various workplace tasks (80 %). However, despite one company where a chatbot application is currently no option, another four companies plan for a future chatbot operation. Thus, the high relevance for chatbot applications for workplace tasks could be shown in our sample, as chatbots are already applied or will be applied soon.



***Note**: Information on the basis of the pre-questionnaire; n=25*

Figure 15 Current Application Situation

2.4.2 Chatbot Usages

As the first step of the analysis, we aimed at identifying fundamental tasks a chatbot can perform (*$RQ_2 1$*) at the digital workplace. These usage scenarios (U_i) typically represent the general functions of chatbots independent of a respective application area. By doing this, our analysis revealed the three usage scenarios or functions of a chatbot: information gathering, process execution, and information provision.

As a first chatbot usage, in the interviews, the **capture of information and data** [U_1] was mentioned (*n*=16) (see Table 18). Thus, different kinds of storage methods through chatbots are addressed. Mostly (*n*=12) our participants, or rather their company, use or plan to use chatbots for the simple task of ***structured data input***. In doing so, often, the technological input basis is a data input form, which is implemented in a chatbot. By knowing the necessary input fields, the chatbot asks the users for their data (EXP22). This basic input functionality can also be extended by the chatbot constantly requesting further information from other systems in addition to the user input (EXP12). Additionally, the information capturing is not limited to written input by the user. As noted by (EXP27), they suggest using the speech for data input. By processing the spoken input, the chatbot is capable of inquiring intelligently only necessary information, and, thereby, translating the input into a simple semi-structured form, e.g., like a secretary. Extending this simple form filling, some participants mentioned an ***unstructured data input*** (*n=7*). For example, one company plans to integrate a chatbot in the communication function of conference tools. By doing this, the chatbot can document and save decisions made in discussions, e.g., by storing either the whole dialog or only relevant excerpts (EXP11). Additionally, one participant uttered the idea that a chatbot can be used as a means for knowledge management systems. By storing the relevant dialogs, the company-wide knowledgebase can be enhanced, and, e.g., new forms of training can be established (EXP27). A further possible usage represents chatbots as a kind of dictation machine. By using a non-specified input, or rather an open question, the chatbot can be used, for things like requirement analysis. In doing so, chatbots generate or capture content belonging to

workplace-relevant topics, which have to be processed further in a different application system (EXP24). Nevertheless, already, the use as a dictation tool represents such a data capturing opportunity.

U_1	**Information Capture**	***n*=16**
Quotes	**Structured Input**	***n*=12**
	"*Concrete example from practice, I think, for example [company name], that is, this direct insurer, are beginning to introduce very simple forms of chatbots, form-based chatbots.*" (EXP22)	
	"*[...] the bot then asks me, for example, "what is your username?" and then it asks for some more information. And with the help of this information, it can then contact other systems to get more information and use all the information it has collected [...]*" (EXP12)	
	"*[…] a running pilot on how to do this time tracking based on phone calls with an automatic dialog, which is very intelligent in speech recognition. [...] to actually get data input by voice or also by dialogues in such a semi-structured form, which one would otherwise have to submit by tablet or excel.*" (EXP27)	
	Unstructured Input	***n*=7**
	"*[...] to introduce a chatbot, which you can invite into the chat as a participant and this bot can then record by commands [...], please note as a resolution on the subject that we now want to proceed as follows […].*" (EXP11)	
	"*You could also use this, e.g., for requirement analysis, if you now want to query requirements from several users, then they can all do their requirements and this query [...] can then be supported by a virtual assistant.*" (EXP24)	
	"*[…] currently it is a running pilot on how to make this work time recording based on telephone calls with an automatic dialog. […] To get data input by speech or dialog into such a semi-structured form, which otherwise have to be submitted by tablet or by Excel or in any other way.*" (EXP27)	

***Note**: Counts based on the 27 interview cases*

Table 18 Information Capture with Chatbots at Digital Workplaces

Besides the usage as a means for data capturing, the companies use or plan to use a chatbot for the **process guidance and execution** [U_2] (*n*=18) (see Table 19). The kind of the underlying process distinguishes between the number of involved participants and the complexity of the process itself. First and mostly (*n*=16), chatbots are used for processes with only a ***single actor***, where this actor communicates with the chatbot exclusively. Chatbots should support the employee to carry out workplace-relevant tasks and processes, like master data changes, travel requests, or software installations. Employees control or execute the whole workflow in the chatbot dialog, fill out necessary fields, or execute corresponding actions (EXP03). However, similarities to the form input usage are existent. This is extended by the fact that the chatbot not only queries the fields, but also intelligently controls the process and data input at any time and, further, automatically starts subsequent tasks and processes. As with the main characteristics, the users only have to speak naturally with the chatbot and thus give him the orders to be executed. The chatbot processes these and executes the corresponding actions, e.g., resetting the passwords for information systems (EXP13). As summarized by one expert, everything, which can be mapped in a process-oriented manner, can be supported by a chatbot (EXP25). However, this can only be done if the process is not dynamical, and every possible further action is known, e.g., in a rule-based process. Second, chatbots can perform processes with ***multiple actors*** (*n*=7), e.g., with approvals by supervisors or in coordination tasks in groups. The chatbot handles, or rather, manages complex rule-based processes, which extends the first group of single actor tasks. In this scenario, the chatbot is capable of handling multiple actors, where every single actor has its own dialog with a chatbot. The chatbot manages between all these individual chats and coordinates the decision process, e.g., in the case of meeting planning where the chatbot finally sets up an appointment (EXP16). Besides the simultaneous coordination between actors, a chatbot can also support processes where different actors are sequentially involved. Like in processes with approvals from supervisors, the

chatbot first guides the user to the initial steps, and then forwards the request to the supervisor, who can accept or reject the inquiry in his chatbot dialog. Afterward, the chatbot can inform the initial user about the decision and start the subsequent steps (EXP01, EXP28). Overall, for this usage, a chatbot manages between all involved actors and responds accordingly so that the process is executed correctly and no steps are forgotten or skipped.

U_2	**Process Guidance and Execution**	***n*=18**
Quotes	**Standardized; Single Actors**	***n*=16**
	"*Of course, such a scenario is a goal of chatbots. [...] to support workflow-based processes in which employees, run through a workflow or just fill out a form, in which fields build on each other [...].*" (EXP03)	
	"*[...] e.g., if someone needs a reset of their SAP password, [...] they could say "I need a new SAP password." Then the chatbot asks back on which SAP systems the reset should take place and then, if [the chatbot] is integrated, it could reset the password and tell the user the new password.*" (EXP13)	
	"*For us, the focus is on ensuring that everything that can be displayed in a process-oriented manner can be sensibly displayed via a chatbot.*" (EXP25)	
	Rule-based; Multiple Actors	***n*=7**
	"*This is the same in essence, but because costs are also involved and other organizational units may also have to be involved in the fulfillment process, there are approval steps and I would rather speak of a rule-based process.*" (EXP01)	
	"*What you would otherwise try by mail back and forth, the bot then actually takes over and controls the whole thing among all participants. [...] every one of them has a personal dialogue and the bot puts the information together, manages it, and finally sets the appointment.*" (EXP16)	
	"*[…] the request prefilled via this channel is then digitally passed on to the approver, who can then very easily say "Released." and the request will be processed further.*" (EXP28)	

***Note**: Counts based on the 27 interview cases*

Table 19 Process Guidance and Execution with Chatbots at Digital Workplaces

Lastly, in all of our cases (*n*=27), the participants suggest using a chatbot for the task of **information provision** [U_3] (see Table 20). Although it is always information, the kind differs between static or predefined information, unstructured or dynamic information, documents/files or links, and reminders. For the subtask of ***static, predefined information*** (*n*=26)***,*** it was mentioned that chatbots are capable of answering simple questions about different topics like technical problems or daily work-related aspects (EXP05). Chatbots should help by answering how to handle or solve these problems. Also, often mentioned was the provision of frequently asked questions (FAQ) content via the dialog of a chatbot (EXP10). These predefined and often regularly returning questions are typical questions handled by first-level service desk employees (e.g., if someone asks for "*question Q?*" give him "*answer A!*"). Besides this, chatbots are capable of inquiring about other workplace-related information for the daily work, e.g., contact persons or responsibilities (EXP20). In the case of ***dynamic, unstructured information*** (*n*=13), chatbots should provide an interface to retrieve unstructured data in a structured way. In opposite to static or predefined information, chatbots can provide actual information, e.g., system status (EXP04). Necessary for this is a logic as well as interfaces to databases, information systems, or (web) services, which enable the provision of all kinds of information, regardless of the location in a timely manner (Exp17). This allows chatbots to optimize the current state of internet or intranet searches through a new natural language-based interface (EXP29). In doing so, present access rights must be taken into account. As a third subtask, seven participants stated that chatbots could ***provide files/documents or links***. Thus, a chatbot is capable of providing the documents or files directly in the dialogue, and a user does not have to search for them manually in their (local) directories (EXP21). As mentioned, employees often do not know which documents they need for a specific task. A chatbot

might thus be a suitable solution for this problem. Also, for example, in the case of accounting, chatbots can provide full documents and may deliver only the relevant snippets (EXP10). Additionally, instead of providing the information in the dialog, the first support for the employees is already the provision of links to the requested resources in other systems (EXP14). Lastly, chatbots can be used to provide ***reminders*** (*n*=2). The experts indicated that chatbots had been used for different reminders in their daily work (EXP23). Also, with their proactive capability, they can suggest automatically corresponding actions on current work tasks, like the mentioned reminders (EXP16).

U_3	**Information provision**	***n*=27**
Quotes	**Static, Predefined Information**	***n*=26**
	"*[…] relieve the workload by building such a service bot, which provides advice and support for all questions relating to minor technical problems and how to handle things that are really simple […].*" (EXP05)	
	"*[…] e.g., Service Desk Q&A just as it is with such a FAQ. Frequently asked questions that run through a service desk, which you could do with a chatbot.*" (EXP10)	
	"*No, only standard questions, responsibilities, contact persons, maybe something like cost centers or something like that. So first of all classic FAQ.*" (EXP20)	
	Dynamic, Unstructured Information	***n*=13**
	"*In my opinion, it could change the future [...] if unstructured data is prepared in a structured way. So what I just meant was, that you ask for system information via a chatbot e.g., Please give me the nightly disturbances from the system.*" (EXP04)	
	"*That you can quickly retrieve information via input, e.g., […] retrieve specific information about customer [...] because implementing a higher-level system that can immediately provide the information via the corresponding logics, regardless of where it is located.*" (EXP17)	
	"The Chatbot is also a relatively good contact point, for everything like information procurement with Intranet [...] currently we have tried out Chatbots to optimize something like Intranet searches." (EXP29)	
	Provide Files/Documents or Links	***n*=7**
	"*[…] also internally there is a lot of interest to make with [chatbots]. e.g., from the accounting that one places there any inquiries and documents or excerpts from documents be returned.*" (EXP10)	
	"*And if it is only a URL call or such things. I also imagine that the chatbot can do that at the end, but not further trigger or perform [a function] [...].*" (EXP14)	
	"*[…] that you are only redirected to the search path of the PDF. Then you can download the PDF via the bot and then you can print it out.*" (EXP21)	
	Reminders	***n*=2**
	"*Then the chatbot [...] would either automatically create an activity or ask, "Should I set a reminder for you again? Should I create an activity for you? [...] that you should ask again, so just a follow-up appointment.*" (EXP16)	
	"*I have several Chatbot mechanisms that just help me be more productive, remind me to do things, and so on.*" (EXP23)	

***Note**: Counts based on the 27 interview cases*

Table 20 Information Provision with Chatbots at Digital Workplaces

2.4.3 Application Areas

As the next step in the analysis, we identified application areas (A_i) of chatbots at the digital workplace ($RQ_2 2$). As a result, our analysis revealed seven potential application areas for chatbots at digital workplaces, which can be further subdivided into divisional and cross-divisional application areas. In addition to the plain identification of these, we link them to our identified tasks ($RQ_2 1$). In doing so, we wanted to identify necessary tasks, as requirement areas, when designing and implementing chatbots for particular application areas. Furthermore, we assessed the deployment scenario (intern vs. extern) of chatbots at the end.

Divisional Application Areas

Our participants noted four potential divisional application areas for chatbots at digital workplaces (see Table 21). In these settings, a chatbot is responsible for specific tasks or processes in a particular division.

Firstly, the participants mentioned potential application areas of chatbots in **internal and/or external support** [A_1], e.g., service help desks in companies or customer service. This was mentioned by 22 experts. As they stated, a chatbot is a new medium for answering questions in the daily work. Thus, employees can get solutions easily for their suffered problems or answers to their issues without asking and disturbing other employees (EXP03). Besides this internal scenario, a chatbot can also enhance the external support with customers or other departments (EXP07). In this case, the goal is to reduce interruptions in service centers through the automation of answering employee as well as customer questions. Thus, the first-level support can be relieved, and they can focus on complex or major concerns. As (EXP23) noted, most of the first-level questions are like "*How do I do …?*", which can all be answered by a chatbot. Therefore, a chatbot must provide information and corresponding content to aid in the task of support in companies [U_3].

Application Area		Usage			∑
		U_1	U_2	U_3	
A_1	**Support (internal/external)**			✗	22
Quotes	"*One [chatbot] is for our [self-service portal], which is available to every employee to answer questions about the working day, not only of a technical nature.*" (EXP03) "*With the chatbot, simple customer inquiries are answered in the Service Center and customer inquiries that would otherwise end up in the Service Center are answered there.*" (EXP07) "*I used to work in one organization which probably had 150 people […] working in a call center to help employees through their HR questions. You know, 70 percent of those questions was, "how do I do …?" and actually, a chatbot is capable of responding to those questions.*" (EXP23)				
A_2	**Human resources**	✗	✗	✗	4
Quotes	"*[…] job offering: What is [company name]? Which jobs does [company name] offer? Who are the contact persons? Such questions are answered here.*" (EXP01) "*There is also a similar form that this [a chatbot] simplifies the application process.*" (EXP05)				
A_3	**Purchase and sales**	✗	✗	✗	9
Quotes	"*On the subject of sales support or in general: "How do our products actually work?" This only applies to our sales staff, which is looking for the best arguments for the (potential) customer.*" (EXP02) "*Preparing an offer [...], but of course I can also continue this afterward very well, if the offer becomes an order, I could also save myself a lot again. Perhaps by saying: "Offer XYZ has become an order".*" (EXP17)				
A_4	**Maintenance**		✗	✗	2
Quotes	"*[...] in the area of maintenance, [...] because specific information is needed and it would be advantageous to have your hands free. [...] So, if I can just query the [required information] by voice [...].*" (EXP17) "*[...] machine maintenance, where a user has to process checklists which are connected to the […] [backend]. There, the chatbot can guide the employee through the process and say: "Do this and that".*" (EXP24)				

***Note**: Counts based on the 27 interview cases*

Table 21 Divisional Application Areas of Chatbot at Digital Workplaces[13]

Secondly, for the case of **human resources** [A_2], four of our participants mentioned that chatbots might support the process of job offers, e.g., to provide information on open vacancies or about the company

[13] The published version uses *task* instead of *usage*.

to applicants (EXP01). Additionally, they can be used to map the whole job application process (EXP05). In this application area, we assume that it has to be possible to retrieve application relevant information [U_3] and map the whole process so that an application can be made entirely via a chatbot [U_2].

Another identified application scenario is **purchase and sales** [A_3] (*n*=9). Our study participants added the potential that chatbots can be used to retrieve product information, e.g., for customer acquisition (EXP02). Besides the information provision as well as the recording of made sales, the chatbot can manage the sales or purchase process. As mentioned by (EXP17), offers can be made, which can further be transformed into real production orders by chatting with the bot. In summary, a chatbot has to be capable of delivering different kinds of content [U_3] as well as guiding through the process [U_2]. Also, it should be possible to capture emerging data and information, e.g., offers or customer data [U_1].

In addition, two experts mentioned the application of chatbots for **maintenance** [A_4], e.g., production facilities or office supplies. It is critical to note that this corresponds strongly with physical work, which was not the focus of this research. However, some experts stated that it should be considered as a field of application, especially in the case of maintenance of office supplies at workplaces. In this case, necessary information can be retrieved through audio in-/output while carrying out maintenance tasks (EXP17). Furthermore, the chatbot ensures that the maintenance process is executed correctly, and no steps will be forgotten (EXP24). As derived from the statements, a chatbot must map the whole maintenance process [U_2] and has to provide necessary information during the tasks [U_3].

Cross-divisional Application Areas

Furthermore, our participants noted three cross-divisional application areas for chatbots at digital workplaces (see Table 22). In these settings, the chatbot makes its functions available to the employees independently of the respective department.

In our coding, we determined the application area of **(employee) self-service** [A_5]. Twenty-one participants noted application areas for this group of workplace duties. One stated application area encompasses typical tasks for the personal organization for daily work. For instance, chatbots can be used for meeting assignments, where the participants can chat with the bot to find a common date (EXP03). Additionally, other (minor) tasks that are typically addressed by self-service portals in companies represent potential application areas for chatbots (e.g., room bookings, requests of documents, as well as master data changes; EXP07, EXP23). Necessary for a chatbot in this scenario is that all of our identified tasks are addressed [U_1-U_3]. Thus, employees can retrieve the requested information, which corresponds to [A_1]. They should also execute the processes (EXP23), as well as have the option to capture or change data. Aside from this, chatbots should forward to systems if they cannot carry out the work directly or set up reminders, e.g., for upcoming tasks or appointments.

Furthermore, some attendees (*n*=9) noted that they see chatbots as a new tool to support **education and training** [A_6] at workplaces. In doing so, chatbots should provide the learning content so that it can be retrieved in the dialog. For example, after product training, employees can retrieve additional information (EXP21). This corresponds narrowly to the process of information provision [A_1] as it is only

about getting information. Another option for employee training is to map the optimal dialog, e.g., a customer support conversation, so employees can learn how to react optimally by taking up the different roles (EXP27). Even if the experts did not mention it directly, learning could be seen as a process where information will gradually be provided depending on the individual progress or ability to learn. Therefore, a chatbot has to provide information [U_3] and carry out the (adaptive) processes [U_2].

In addition, we found evidence in 12 interviews that chatbots are a viable tool for **knowledge or information management** [A_7]. Most of the mentions belong to the already outlined provision of information or knowledge, which are stored in large databases (EXP15). Additionally, some experts mentioned that chatbots could be used as a source of a dynamic knowledge store, where dialogs or their results are stored and been reused later, e.g., for the training of employees or documentation (EXP27). To be capable of supporting knowledge and information management, a chatbot has to deliver the requested information [U_3] as well as collect new information to expand and enhance the current state for the future [U_1]. As in total, this application area corresponds nearly with the provision of information [A_1], as one typical requirement is to provide employees with necessary information. However, this is extended by structured information storage [U_1].

Application Area		Usage			∑
		U_1	U_2	U_3	
A_5 **(Employee) Self-service**		✗	✗	✗	**21**
Quotes	"*Things like making appointments and coordinating appointments for groups.*" (EXP02) "*[...] e.g., making room bookings via chatbots, that you can ask what's in the canteen today, that I can change my (private) address […]. That if I need any forms, like duration of employment or payslips [...] things like that.*" (EXP09) "*[…] IT Service Desks, where I can, for example, request a token for remote access or a new [employee card], etc., [...] and not only "Where can I find the holiday request?" but also cover such processes automatically […].*" (EXP16)				
A_6 **Education and training**			✗	✗	**9**
Quotes	"*[...] for example to let lectures run over the chatbot again. Not by a monologue, but that participants have a chatbot for repetition as a tutor, whether terms are understood correctly for example.*" (EXP21) "*[…] chatbots for employee training, that the employees can conduct such dialogs from the perspective of the provider or the customer in order to get a feeling for what the right answers are and at the same time the knowledge can be made available to the employee in a supportive way.*" (EXP27)				
A_7 **Knowledge and information management**		✗		✗	**12**
Quotes	"*Where one has deposited relatively much information in a knowledge portal, where then the chatbot could navigate through it or refer to corresponding functionalities [...].*" (EXP15) "*What we find quite interesting is the component of the chat, which at some point is learning in a certain way [...]. This then develops from a pure knowledge machine to a dynamic knowledge store, which is also better maintained than classic knowledge management systems.*" (EXP27)				

***Note**: Counts based on the 27 interview cases*

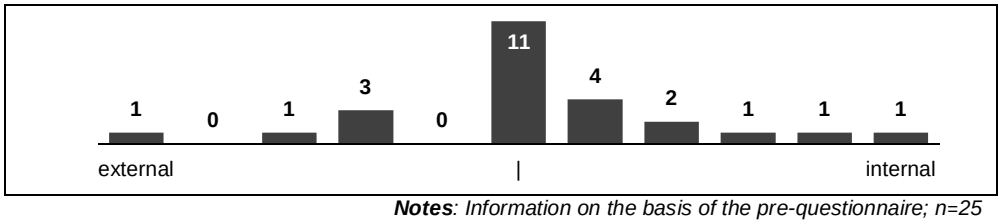
Table 22 Cross-Divisional Application Areas of Chatbot at Digital Workplaces[14]

Deployment Scenario

Extending this examination, we briefly wanted to rate the viable deployment scenario (internal or external) for chatbots to assess if practitioners confirm the current research projects, which focus mainly on external scenarios, e.g., customer support. Based on our pre-questionnaire (*n*=25), we surveyed this with an 11-step slider (see Figure 16; external: e.g., customer support, FAQs; internal: e.g., employee

[14] The published version uses *task* instead of *usage.*

self-service, business processes). As shown, our participants mostly selected the middle position, which indicates that the application is suitable for both internal and external use cases. Therefore, our participants see both cases as a viable application area, instead of focusing only on the previously studied application of chatbots in customer support areas (external), which is contrary to the current research. What is to mention, some respondents note that an employee, e.g., from a different department, can also be regarded as external.



***Notes**: Information on the basis of the pre-questionnaire; n=25*

Figure 16 Deployment Scenario

2.4.4 Objectives

As a last step in the analysis, we survey the underlying objectives (O_i) of a chatbot operation at digital workplaces ($RQ_2 3$). Therefore, we collected corresponding mentions and categorized them. Additionally, we assigned the identified objectives to main categories quality, quantity, time, or cost.[15] Furthermore, we analyzed dependencies between the particular objectives and used them for the categorization, resulting in three levels from direct over mid-level to indirect objectives (see Figure 17).

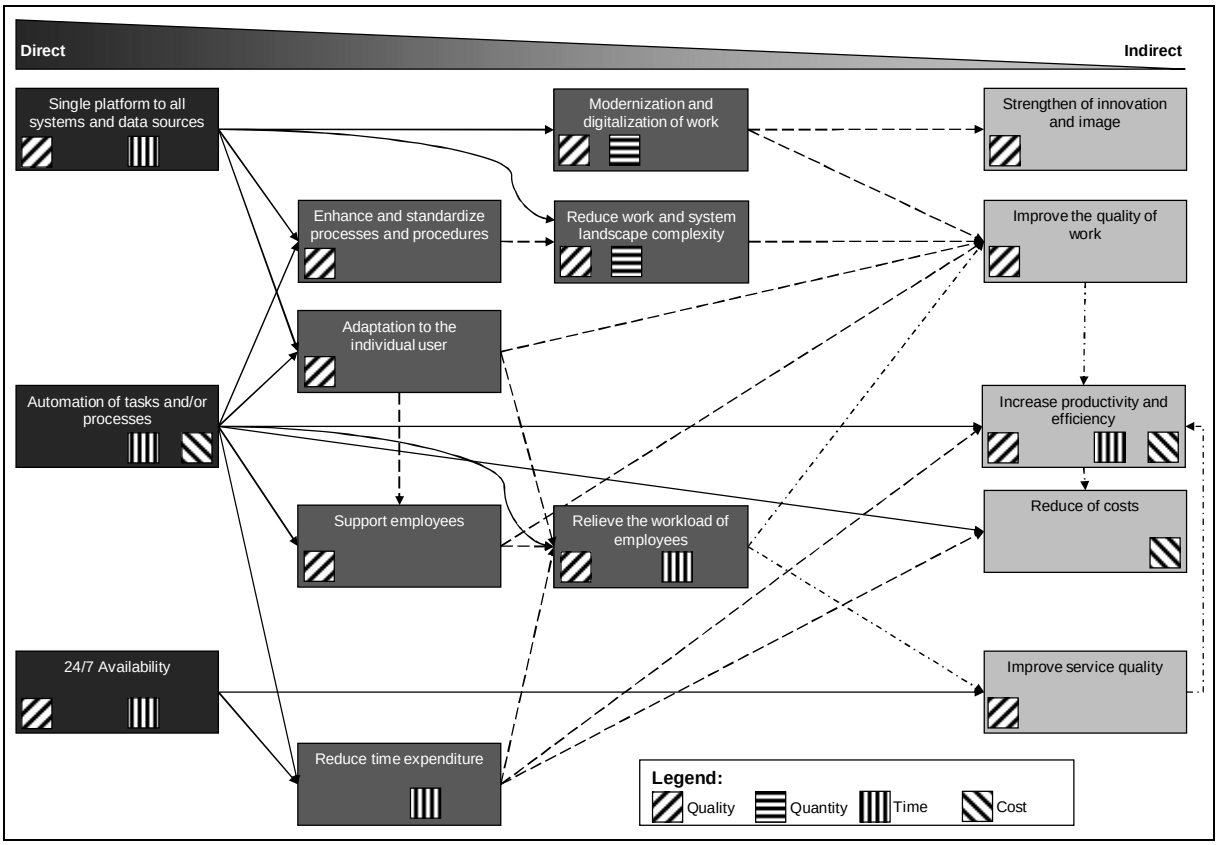


Figure 17 Objectives and their Dependencies of a Chatbot Operation

[15] Based on the *Devil's Quadruple* of SNEED/MEREY (1985). See also MEYER VON WOLFF/SCHUMANN (2019).

Direct Objectives

Based on the analysis of the dependencies illustrated above, we could identify three starting, direct objectives (see Table 23; see Figure 17: left side, black background).

Most of our participants mentioned hereby that they would operate a chatbot as a means of accessing available application systems (*n*=16). Thus, a chatbot provides a **single platform to all systems and data sources** [O_1] (EXP12, EXP22). By doing this, a chatbot provides a unique entry point for different functionalities. Thus, access to these functionalities is independent of a specific device, and users do not need to install specific software. They can simply use it by expressing natural utterances.

Furthermore, chatbots should **automate tasks or processes** [O_2] (*n*=15). According to our participants, repetitive and time-consuming tasks should be chiefly taken over by the chatbot (EXP10). Extending this, automation across system borders is pursued, so that complete processes are automated instead of only single functions (EXP27).

The last identified primary objective is the **24/7 availability** [O_3] of services (*n*=11). The chatbot is always available and provides its functions regardless of date or time. Additionally, chatbots are not dependent on human resources. Therefore, they can process multiple inquiries simultaneously, which is especially valuable in rush hours, when users or employees have to wait for a support employee or help (EXP13).

Objectives		∑
O_1	**Single Platform to all Systems and Data Sources**	**16**
Quotes	"*But I rather believe that channel independence in the sense that you don't have ten or twenty different apps anymore, but that you could simply say [...] "Chatbot XYZ, I have to open [...] a ticket" and then the chatbot knows which data belong into the ticket system and can query it or extract it from the statement [...].*" (EXP12)	
Quotes	"*AI has arrived when this change between applications is no longer necessary; when I basically have one desktop and the AI knows exactly what I want to change and where.*" (EXP22)	
O_2	**Automation of Tasks and/or Processes**	**15**
Quotes	"*[...] tasks that are repetitive, [...] that normally take a lot of time and that can be solved faster by such a chatbot.*" (EXP10)	
Quotes	"*In the long term, it is precisely this convenience factor that the dialog component also offers the automation of processes and process steps, especially across system boundaries.*" (EXP27)	
O_3	**24/7 Availability**	**11**
Quotes	"*Availability should be guaranteed 24 hours a day, 7 days a week for the customer.*" (EXP07)	
Quotes	"*The possibility of parallel processing of requests is of course also very interesting for us. We have, especially in the Help Desk, certain rush hours where [...; this one] is not available [...] and I would expect [a chatbot] to be able to serve countless sessions at the same time.*" (EXP13)	

***Note**: Counts based on the 27 interview cases*

Table 23 Direct Objectives

Mid-Level Objectives

Following the primary objectives, our participants noted seven mid-level objectives, which are indirectly addressed by the primary ones (see Table 24; see Figure 17: dark grey background).

Firstly, our participants noted a **modernization and digitalization of work** [O_4] (*n*=14), as available systems will be provided via natural language interfaces [O_1]. Particularly, the digital natives expect private-known technologies at the workplace (EXP01). Also, employees often want to use a natural, interactive format instead of form-based menus or classical user interfaces (EXP27).

Secondly, existing **processes and procedures should be enhanced and standardized** [O_5] (*n*=9). Due to automation [O_2], among others, the work effort should be reduced (EXP23). Additionally, process improvement is intended by having standardized, uniform answers, and the supply of contents (EXP13).

Based on this, the **complexity of work and in the system landscape should be reduced** [O_6] (*n*=3), as only one single user interface must be used [O_1] (EXP01, EXP23). This makes it irrelevant as to whether users communicate with other employees or control enterprise systems since, for both, only the chatbot as a communication tool must be used.

Objectives		∑
O_4	**Modernization and Digitalization of Work**	14
Quotes	"W*hat I perceive privately in the information technology environment, that's what I would like to call contemporary and that's what I expect in my professional environment as well.*" (EXP01) "*[...] Adoption to the new communication habits of the digital natives [...] All employees of the [company name] say [...] that they would rather use an interactive format, like a chatbot via different messengers, than a telephone contact, so simply the channel preference.*" (EXP27)	
O_5	**Enhance and Standardize Processes and Procedures**	9
Quotes	"*[...] transparency in the processes and a certain standardization, because once a case has been solved in a certain way and the next user calls and [...] has the same problem, you can be sure that the same solution will be used again.*" (EXP13) "*My feeling is that chatbots can really help simplify what is otherwise a quite complex process.*" (EXP23)	
O_6	**Reduce Work and System Landscape Complexity**	3
Quotes	"T*here are all these complex systems [...] that affect everyone in a company, and now you let the user communicate in the usual way through a chatbot, which makes it a bit less important whether it's a human or a machine. Chatbots make it possible to cope with this complexity.*" (EXP01) "*A chatbot should make things less complex, it should make things easier for […] a user and the only way they will do that is, if they replace or streamline existing processes, which would include deep API connections […]*" (EXP23)	
O_7	**Adaptation to the Individual User**	12
Quotes	"*The [form-based system] is very complicated and the chatbot is a good instrument to establish a guided rather colloquial communication in the office environment.*" (EXP19) "*It is always promised that technology will adapt to us, but this is still not the case, and chatbots promise to do so because they adapt to the user and provide him with the information and use cases he needs [...]"* (EXP25)	
O_8	**Relieve the Workload of Employees**	19
Quotes	"*If the guys and girls in the IT-department don't have to worry all day about confusing calls, they can focus on more important, exciting things […]*" (EXP05) "*The [chatbot project] would mean a considerable simplification for the employee but also a reduction of the effort.*" (EXP28)	
O_9	**Support Employees**	12
Quotes	"*We want […] to support people and not replace them, and in particular the AI should not independently make decisions that are critical, but that people can still make the decisions […]*" (EXP12) "*I see the commitment primarily in the support of employees at modern workplaces. [...] I think really good chatbots will react context-sensitive in the future and not on our command.*" (EXP22)	
O_{10}	**Reduce Time Expenditure**	20
Quotes	"*[...] but much more. Employees [...] come very quickly without a call, and from everywhere, to an answer by just using this chatbot. [...] So just speed as an objective.*" (EXP03) "*We see the topic of response speed, where some simple requests can remain for a long time, if there is a large volume of inquiries, one is served faster here.*" (EXP27)	

***Note**: Counts based on the 27 interview cases*

Table 24 Mid-level Objectives

Furthermore, the **adaption to the individual user** [O_7] (*n*=12) is an objective. The natural language user interface [O_1] of a chatbot is intended to establish natural communications between an employee

and the application systems (EXP19). Even though it has been pursued for a long time, chatbots should achieve this by filtering and providing only actually needed information (EXP25).

In addition, the chatbot operation should **relieve the workload** [O_8] (*n*=19). By answering standard queries automatically, employees can concentrate on their actual daily tasks (EXP05). This should also make it possible to streamline work, and, thus, release human resources (EXP28). Thus, the employees can focus on more relevant tasks instead of just answering simple questions all day long.

Also, **employees should be supported** [O_9] (*n*=12) in their daily work. Based, e.g., on the (partly) automation [O_2], processes are accelerated, as employees only have to make (critical) decisions (EXP12). Furthermore, the chatbot can guide a user through information acquisition by using stored structures or by refining the initial question. Thus, it provides support for users who do not know how to search, or what they are looking for, are supported in a targeted manner by the chatbot, which asks specific questions until a solution is found (EXP22). In addition, the pro-activeness supports by allowing a chatbot to independently perform or prepare actions as well as reacting to the current work situation.

As the last identified mid-level objective, we gathered the most mentions on **reducing time expenditures** [O_{10}] (*n*=20). Particularly through the automation [O_2] and using a single device-independent interface [O_1], employees can retrieve information or get help in a timely manner whenever needed (EXP03, EXP25). Additionally, since answers are not dependent on real employees, users do not have to wait for response calls or e-mails.

Indirect Objectives

Following the mid-level objectives, we identified five indirect objectives (see Table 25; see Figure 17: right side, light grey background).

Our participants mention thereby the **strengthening of innovation and image** [O_{11}] through a chatbot operation (*n*=4). Already the provision of chatbots can increase the firm image and contribute to positive customer retention (EXP11).

Additionally, a result of the chatbot operation is the **improvement of work quality** [O_{12}] (*n*=12) by, e.g., supporting employees [O_9] or automating tasks [O_2]. This should lead to increased motivation and more time for important tasks (EXP12). However, negative effects due to work compression through decreased freedom could be possible. In general, also improvement of the working conditions is in the focus of the chatbot operation (EXP19).

Extending this, an **improved service quality** [O_{13}] is intended (*n*=2). For example, through the 24/7 availability [O_3], help is available permanently, and the company can adapt to international requirements (EXP11). Besides this, instead of searching through FAQ pages, inquiring users can get a personal and targeted answer (EXP26).

Furthermore, an objective of chatbots is the increase in **productivity and efficiency** [O_{14}] of employees (*n*=13). Thus, the various capabilities, and previously mentioned objectives, such as automating tasks [O_2] or relieving employees [O_8], lead to increased productivity in daily work (EXP15, EXP18).

As the last and foremost goal, our participants noted **reduced costs** [O_{15}] through a chatbot operation (*n*=19). There are various savings effects, as already indicated in the previous objectives, e.g., by automating processes [O_2], or releasing capacities [O_8] (EXP08). But to mention is that cost savings are just a consequence of the operation instead of a primary objective (EXP25), which is also shown in the dependencies of objectives (see Figure 17).

Objectives		∑
O_{11}	**Strengthen Innovation and Image**	**4**
Quotes	*"Because of the service quality, such a bot can also lead to the fact that the innovative power of a company is simply strengthened in order to show to the outside world in terms of market technology, yes, we are very hip with the new technologies*." (EXP11) "*But the triggering impulses at the moment are actually customer loyalty, modern innovative communication channels, customer journeys, where to score positively somewhere*." (EXP19)	
O_{12}	**Improve the Quality of Work**	**12**
Quotes	"*[...] support the human resources on the one hand so that they have more fun in their daily job and accordingly are naturally free for other tasks.*" (EXP12) "*[...] the added value consists of establishing the control or the guidance of the dialogue flow there [...] and that in so far the chatbot provides an improvement in the working environment*." (EXP19)	
O_{13}	**Improve Service Quality**	**2**
Quotes	"*[...] a chatbot is permanently accessible independent of normal working hours. This increases the quality of service.*" (EXP11) "*[...] it is about a machine talking to a person and the more sophisticated the artificial intelligence behind it is, the more charming it is and ultimately it is about increasing customer satisfaction, i.e. the customer satisfaction of internal or external customers.*" (EXP26)	
O_{14}	**Increase Productivity and Efficiency**	**13**
Quotes	"*The fact is, we would use that to drive efficiency gains.*" (EXP09) "*[...] of course a chatbot is also a real efficiency factor, if he is able to do all the work himself before a real employee has to do it and takes care of it, then you definitely have a real efficiency advantage.*" (EXP15)	
O_{15}	**Reduce Costs**	**19**
Quotes	"*In such a professional call center a call answering [...] costs 8-10 Euro. If I now establish a chatbot and it takes from 10.000 tickets per month [...] 2.000 away and costs only fractions of it, then, of course, I also have this economic effect.*" (EXP08) "*It is correct to speak of cost savings, but of course this is only a consequence of the whole [project; ...]*" (EXP25)	

***Note**: Counts based on the 27 interview cases*

Table 25 Indirect Objectives

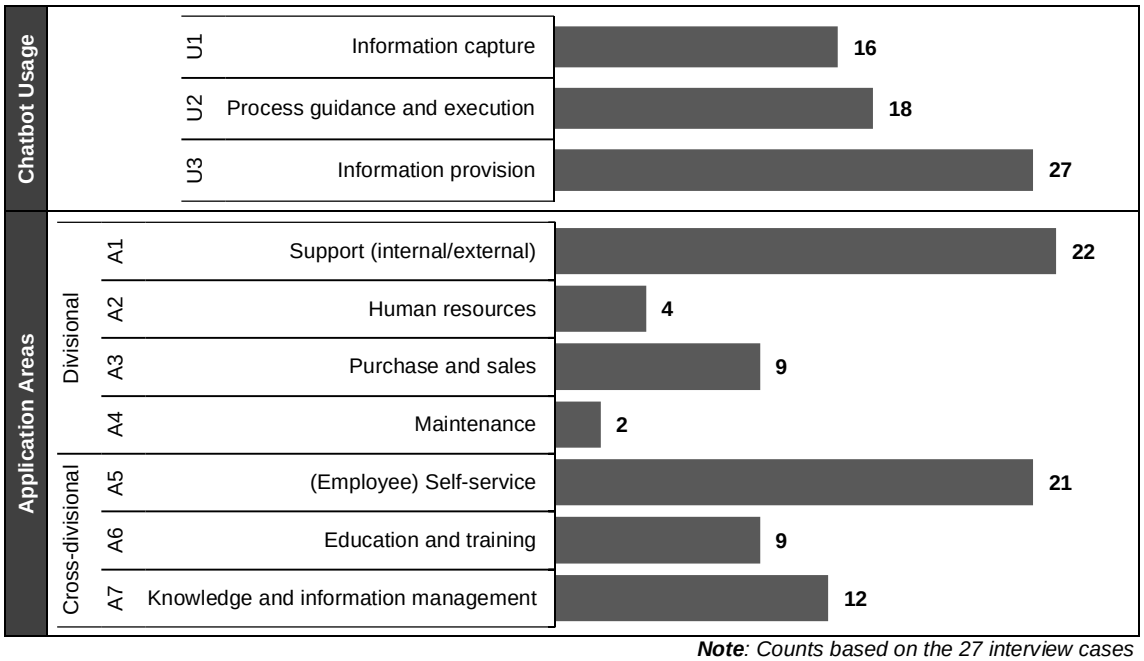
2.5 Analysis of the Results

Overall, we identified three relevant usage scenarios for chatbots (see Figure 18). Although, of course, all of them are relevant, the distribution of mentions differs. Mostly, chatbots should *provide information in different kinds* [U_3] (*n*=27) as well as *execute processes* [U_2] (*n*=18). In addition, we surveyed specific application areas mentioned by our participants and identified seven potential application areas for chatbots at digital workplaces. As with the usage scenarios, all application areas can be relevant, depending on the specific case in a company. However, our experts particularly highlight chatbots in the areas of *(internal/external) support* [A_1] (*n*=22) as well as supporting the *(employee) self-service* [A_5] (*n*=21).

Furthermore, we could combine our identified usage scenarios with the application areas, based on the mentions of the experts as well as on argumentative deductive conclusions made by us. By doing this,

we could highlight necessary tasks or, rather, requirements for chatbots in each of our application areas. It is worth mentioning that the *(internal/external) support* [A_1] is the most specific use case, as only tasks of content provisions are required. On the opposite, the *human resource* [A_2], *purchase and sales* [A_3], and *(employee) self-service* [A_5] are the most diversified, as all tasks can be relevant for the specific use cases. However, the *(employee) self-service* is the most mentioned application area from these three. Also, independent of the application area, chatbots always operate as a medium to provide relevant information. As we pointed out all the relevant tasks, we should note that the actual selection of addressed tasks within an application area depends on the intended use case. For example, if a company plans a chatbot just for providing information on regulations of business trips in a *self-service* [A_5] setting, probably only the *information provision* [U_3] is relevant but not the *execution of processes* [U_2] or the *collection of data* [U_1]. However, based on our findings, we can argue that chatbots can mostly be utilized for information provision along with the execution of corresponding processes, as these combinations were nearly found in all application areas.

Critical to mention on our results is that the identified application areas might not be completely selective. As indicated by the gathered data, dependencies among application areas exist. For example, the process of learning starts with querying about the learning content, which can be seen as *information management* [A_7]. The same can be seen for *maintenance* [A_4], where sometimes meetings have to be scheduled [A_5] or knowledge has to be retrieved [A_1, A_7].

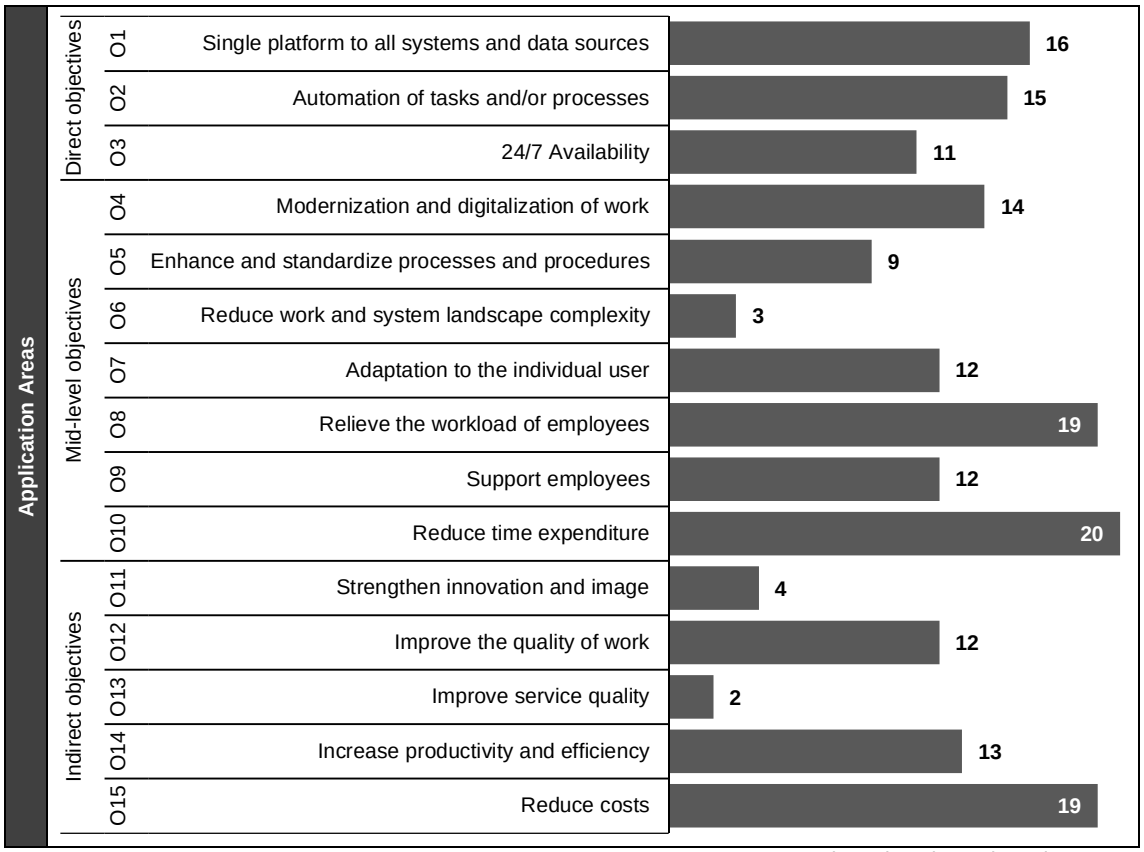


***Note**: Counts based on the 27 interview cases*

Figure 18 Distribution of Chatbot's Tasks and Application Areas

Furthermore, we identified 15 underlying objectives of a chatbot operation at digital workplaces (see Figure 19). Extending this, we could split them into three stages from direct to indirect objectives, based on the examination of dependencies between the objectives. The main goals of chatbot applications are *unified single access to existing application systems and databases* [O_1], *automation of tasks and processes* [O_2], and *24/7 availability* [O_3]. On the other hand, *strengthening of innovation and image* [O_{11}], *increase of work quality* [O_{12}], *increase of service quality* [O_{13}], *enhanced productivity* [O_{14}], and *reduction of costs* [O_{15}] are only tackled indirectly. In the case of dependencies, we identified that

the *automation of tasks and processes* [O_2] has the highest impact on other (downstream) objectives. Also, the *increase of work quality* [O_{12}] is affected by the most (upstream) objectives. This is also shown in the mapping with the objective categories (see Figure 17), as 12 objectives have an impact on quality aspects. Overall, the most mentioned objectives, and therefore the main reasons for a chatbot application, are the *reduction of time efforts* [O_{10}], *relief of employee' workload* [O_8], and *reduction of costs* [O_{15}]. To mention is that none of the most mentioned objectives is a primary or direct objective. Maybe our participants see the direct objectives as fundamental and therefore focus more on specific effects (mid-level and indirect objectives). Additionally, we could show that quality aspects are targeted most often by the objectives, followed by time aspects (see Figure 17), which underlines the aim of enhanced work and workplace quality. However, the quantity and cost categories are targeted only by a few objectives.



***Note**: Counts based on the 27 interview cases*

Figure 19 Distribution of Chatbot's Objectives

Lastly, we analyzed the application areas in combination with our objectives and mapped both concepts on deductive conclusions, and mentions in our transcripts (see Table 26). As seen, especially with the *(internal/external) support* [A_1] and the *(employee) self-service* [A_5], the most objectives will be pursued. Additionally, the *24/7 availability* [O_3] sets a goal for all application areas. Following that, the *increase of productivity and efficiency* [O_{14}] is relevant in nearly all application areas, except in e*ducation and training* [A_6]. The furthermost relevant objectives are the *enhancement and standardization processes and procedures* [O_5], the *relief of workload* [O_8], and the *support for employees* [O_9], which are relevant in five of seven application areas. In contrast, improved *service quality* [O_{13}] is only followed by the application of chatbots in *support* [A_1]. This result shows analogies with the previous result of application

areas and confirms the most interesting areas of use for chatbots as the *(internal/external) support* [A_1], which is the most specific, and the *(employee) self-service* [A_5], which is the most diversified, address the most of our identified objectives.

		Objectives															
		O_1	O_2	O_3	O_4	O_5	O_6	O_7	O_8	O_9	O_{10}	O_{11}	O_{12}	O_{13}	O_{14}	O_{15}	
		Single Platform to all Systems and Data Sources	Automation of Tasks and/or Processes	24/7 Availability	Modernization and Digitalization of Work	Enhance and Standardize Processes and Procedures	Reduce Work and System Landscape Complexity	Adaptation to the Individual User	Relieve the Workload of Employees	Support Employees	Reduce Time Expenditure	Strengthen Innovation and Image	Improve the Quality of Work	Improve Service Quality	Increase Productivity and Efficiency	Reduce Costs	**∑ Sum total**
Application Areas																	
A_1	Support (internal/external)		✗	✗	✗	✗	(✗)	✗	✗		✗	✗	✗	✗	(✗)	✗	**13**
A_2	Human Resources			✗	✗	✗		✗	✗		(✗)	✗			(✗)		**8**
A_3	Purchase and Sales	✗	✗	(✗)		(✗)			✗	✗					✗		**7**
A_4	Maintenance			✗		✗	✗			✗			✗		✗		**6**
A_5	(Employee) Self-Service	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗		✗	✗	**14**
A_6	Education and Training	(✗)		✗	(✗)			✗		✗		✗				(✗)	**7**
A_7	Knowledge and Information Management	✗		✗			✗		✗	✗	✗		(✗)		(✗)		**8**
	∑ Sum total	**4**	**3**	**7**	**4**	**5**	**4**	**4**	**5**	**5**	**4**	**4**	**4**	**1**	**6**	**3**	**63**

***Notes**: ✗ represents that an objective can be addressed with a chatbot in the particular application area; (✗) means a lesser significance of the match.*

Table 26 Mapping of Application Areas and Objectives

2.6 Discussion and Implications

With our study, we contribute to the existing research on application areas of chatbots at digital workplaces and the objectives of a chatbot operation. The aim of our study was to identify these based on an empirical explorative interview study with domain experts for the chatbot application at professional workplaces. In doing so, our findings show that chatbots can carry out three fundamental tasks, which are necessary for each of the seven application areas. Therefore, we could point out possible application areas and their corresponding requirements. Furthermore, we identified 15 objectives in three influencing stages that are to be achieved through a chatbot deployment in workplace settings.

2.6.1 Discussion of the Results

Based on our research questions, we discuss our results of the explorative study in the following. Furthermore, we also compare our results with the scientific knowledge base and show starting points for subsequent research contributions.

$RQ_2$1: Which usage scenarios can be performed by chatbots at the digital workplace?

Even if it was only a small part of the study, we could show that chatbots can be used for information capture, process guidance, as well as information provision. Thus, our results show that chatbots are applicable in more cases than *information provision*, which is one of the most surveyed research areas as of now. Instead, also the *information capture* and the *process execution* seem viable use cases for chatbots. Nonetheless, *information provision* seems the most valuable usage scenario based on the mentions of our participants, which confirms the relevance of this research field.

Thus, we could verify the provision of information or documents as a functional affordance of chatbots at digital workplaces, for example, as shown previously in STOECKLI ET AL. (2018). Their study was conducted among mostly Swiss companies. As we confirmed their results, it can be expected that the findings are independent of a particular country or a specific cultural group but in any case for European Countries. However, as both Swiss and Germany have a similar basic cultural attitude and belong to the European area, this does not necessarily mean that the results are also valid for the rest of the world. Thus, our results can only indicate that the identified tasks could be generalizable across all countries and can, serve as a starting point for further studies. Therefore, our study or alternative approaches should be applied to other countries in order to achieve generalizable results with the help of these. As, to the best of our knowledge, this is necessary, since comparable studies exist only as in the case of STOECKLI ET AL. (2018). Thus, research effort is still necessary for validating usage scenarios as we could only strengthen the research basis with German findings. However, as typically workplace tasks are similar across companies worldwide, the tasks do not differ significantly, which also supports the assumption that results are generalizable. In addition, our identified usage scenarios reflect the typical Input-Process-Output (IPO) model of application systems (Grady 1995). This proves that a chatbot is not only a tool to provide information, but rather an application system that can support the entire data processing process. Consequently, future studies should adapt to these further interesting usage scenarios to study them in detail, instead of continuing to examine only the already extensively investigated area of information provision.

$RQ_2$2: What are the possible application areas for chatbots at digital workplaces?

One of the main aims of our research contribution was to identify possible application areas of chatbots at digital workplaces. In doing so, we identified seven viable application areas: *support (internal/external)*, *human resources*, *purchase and sales*, *maintenance*, *(employee) self-service*, *education and training*, and *knowledge and information management*. Especially, the *support* and the *self-service* state interesting application areas, as most of our participants mentioned them. Furthermore, we could combine the identified application areas with the usage scenarios. In doing so,

we highlight the requirements of the respective application area, which can be used as a starting point for upcoming instantiations in a respective area.

In comparison to the state of the art, e.g., as shown in MEYER VON WOLFF ET AL. (2019a), we also identified customer support and education as an application area. However, we also show further application scenarios that have received less to no attention by researchers so far, e.g., self-service or human resources. Therefore, as in current research contributions, the focus lies primarily on information acquisition or customer support, we could extend the current scientific knowledge base with further viable application scenarios. This is substantial, as it supports our initial assertion and verifies the relevance of the research on application areas at the digital workplace. Nonetheless, especially for information acquisition or support, as there is already a lot of research available, the corresponding previous findings should be transferred for the application domain of a digital workplace. Especially, design principles or meta-research on the users' perspective are suitable since they are more likely generalizable and context-independent. As shown in the related research, e.g., the design recommendations for customer service chatbots (Gnewuch et al. 2017) or human-like response behavior (Liebrecht/van Hooijdonk 2020) are likely to be transferred. Additionally, our results verify some of the previous contributions on (general) application areas. We could verify the application areas information search, e.g., finding answers to questions, and work support, e.g., assisting in office tasks, of LAUMER ET AL. (2019b) as relevant for a chatbot operation. However, since many of their use cases also represent more consumer-oriented applications, e.g., smart home, car & navigation, it must be critically examined whether all results play a role in a business area. Furthermore, we could confirm the findings of FENG/BUXMANN (2020), who highlight chatbots for information retrieval, for routine assistance, or as a working tool. However, even if there exists a vast amount of previous knowledge in transferable areas, e.g., education or information acquisition, none of them focus on the business or professional workplace context. Thus, there should be further research on how to transfer the previous results accordingly, and more importantly, which results are suitable for the corporate contexts. Our study provides a basis for determining which application areas can be considered, and, thus, which related research should be taken into account. However, as with the usage scenarios, our results apply for the time being only to German companies, and thus, should be surveyed in different countries as well to verify or refuse them. Nevertheless, since no comparable studies – to the best of our knowledge – exist that target the professional workplace, we provide first research results and a good starting point for upcoming research in this area.

Additionally, as our results were examined explorative, the findings should be further verified in future research. Therefore, *Design Science Research* projects could be a possible approach (Vaishnavi et al. 2019). In doing so, based on our results, chatbots could be developed and evaluated. Another alternative could be the *Task-Technology-Fit Theory* (Goodhue/Thompson 1995), or rather the *Fit-Viability Theory* (Tjan 2001). This has already been previously highlighted in RZEPKA/BERGER (2018) as a main research topic for chatbots. Consequently, the characteristics of a specific use case must be determined, which are used afterward to determine the suitability of chatbots for the respective case. In doing this, reasonable evidence to support our identified application areas can be collected.

$RQ_2$3: What are the objectives of a chatbot application at digital workplaces?

Furthermore, we analyzed the objectives of a chatbot application at a digital workplace. Our results show that in total, fifteen objectives exist, which are associated with a chatbot adoption. Consequently, a *single platform to information and application systems*, the *automation of tasks and processes*, and a *24/7 availability* represent the primary objectives of the companies. In the end, chatbots should *strengthen the innovation of a company*, *improve the quality of work and service*, *increase productivity*, or *reduce costs*. In doing this, we could show a prioritization of objectives for chatbot applications at the digital workplace, and highlight which aspects are especially relevant. Additionally, we could match the objectives with our identified application areas. In doing so, we found evidence that, especially, the *support and the self-service* are interesting application areas since the most objectives can be addressed if a chatbot is used for this. This can also confirm the current research focus on support tasks since many objectives can be addressed by this application. However, for the task of *self-service*, where likewise, many objectives can be achieved, extensive research is missing, and should therefore also be promoted in the future.

Furthermore, a survey of underlying objectives has only been conducted in previous studies by RZEPKA (2019), whereas the focus was voice assistants and not chatbots. Nonetheless, their fundamental objectives, e.g., maximize efficiency or ease of use, and minimize cognitive effort, can also be found in our results. Thus, we did fundamental research on objectives for a chatbot application at workplaces by showing a comprehensive overview of them on an organizational level. Therefore, we could substantially provide further knowledge to the scientific knowledge base by confirming the findings of RZEPKA (2019) for chatbot applications, and extending preliminary results of MEYER VON WOLFF ET AL. (2019a). However, as already stated, the results are based on a German sample for the time being and, therefore, have to be transferred and validated in future studies. For this purpose, our study and the structured procedure can be adopted in order to collect the results in other countries and to check our results so that actually generalizable results are available.

Additionally, some of our identified objectives refer to concepts, which are investigated before for many other classes of systems. For example, a single point of access to business resources, was subject to research formerly, e.g., with business portals (Rahim et al. 2005; Urbach et al. 2010). The same applies to concepts like automation, which is, of course, not a new research stream and is today mainly considered as robot process automation (van der Aalst et al. 2018). Also, as some researchers state that chatbot is a means for robotic process automation (Maedche et al. 2019; Mendling et al. 2018), it would be viable for future studies to try to transfer the achieved results of this research stream.

However, besides, e.g., natural access to enterprise systems or adaptation to the individual user, many of our identified objectives are very general, and rather aspects of a digitalization strategy. Either this proves that a chatbot is a means to implement these strategies, or the participants have deviated from the actual focus. Thus, future studies are necessary to confirm our exploratory objectives, or to transfer results of digitalization research to the chatbot context. In addition, as already shown in the previous study of RZEPKA (2019), many of the objectives can be mapped to typical constructs of UTAUT (Venkatesh et al. 2016) and TAM (Davis 1993), e.g., automation of tasks and processes, enhance of processes, reduce of complexity, or relieve of workload, which refers to constructs like performance or

effort expectancy in UTAUT, or ease of use and usefulness of TAM. Thus, those theories should be considered when verifying or applying our identified objectives. However, since not all objectives can be mapped directly, future research should address this by establishing a new theory for chatbot applications at digital workplaces. Ideally, the theory to be created should integrate not only our objectives but also the identified usage scenarios and application areas.

2.6.2 Implications for Science and Practice

Summarizing the findings, we could provide several contributions to both scientific knowledge and practice. For scientific knowledge and upcoming research in this area, we firstly show interesting and viable application areas of chatbots in a professional working context. In doing this, we also highlight briefly usage scenarios for which a chatbot can be applied. Due to the generalizable combination of usages and application areas, this can be used as a starting point for respective implementations in future research projects. Thus, future research should adopt these findings for their specific context or use case. Additionally, by showing comprehensive objectives of a chatbot application, we could highlight necessary characteristics for future chatbot applications and instantiations. As with the application areas, we also show that adjacent research exists, which should be transferred and reused. Overall, we could address the previously deduced research topics and agendas in chatbot research (Bawack et al. 2019; Maedche et al. 2019; Meyer von Wolff et al. 2019a). Therefore, we could show usage scenarios and application areas at the digital workplace that should be followed in future studies, and significant objectives for such an operation. Thus, upcoming studies can build upon our results and design corresponding chatbot instantiations in a targeted manner taking into consideration supportive factors, like our objectives.

For practice, we point out viable application areas, in which a chatbot can be used, and should be implemented to support the employees in digital workplace settings. With this, we also establish a starting point for a requirements analysis in businesses. Additionally, we could show what effects can be expected from a chatbot operation. In doing so, we help practitioners with selection decisions when it comes to using chatbots or not. Thus, our results can be used as a guideline for chatbot projects in practice applications or for adoption decisions.

2.7 Limitation and Outlook

As with every qualitative study, there exist some potential limitations, which need to be pointed out. Firstly, the findings of our study are mainly dependent on the selection of interviewees and their willingness to participate as well as on their knowledge about the topic. Therefore, we carefully selected a suitable amount of experts (n=29) for (future) workplace design under consideration of chatbots and sent an information sheet in advance of the interviews. However, possible misunderstandings of the topics, as well as digressive executions from the actual context, are possible, e.g., the objectives, which are sometimes more generally for AI applications in general instead of focusing on the digital workplace. Furthermore, we have not limited the industry sector to survey a cross-section in the research area to achieve generalizable results and to weaken the impact of individual areas. Nonetheless, we could not

acquire interviewees from all sectors. For instance, no participant works in machinery and plant engineering. In addition, the information and communication industry seems overrepresented in our sample. We explain this as experts from outsourced IT-departments or (exclusive) IT-business partners, e.g., for insurance or automotive, participated. Furthermore, the most limiting factor is the sample group of predominantly employees of German companies. Thus, the results apply first and foremost to this country. However, we (1) analyzed the topic independent of a specific industry based on the general professional, nowadays digitalized workplace, and (2) business processes and related basic working practices are standardized worldwide nowadays. Thus, we argue that the results are most likely generalizable. Hence, if companies want to apply chatbots, they can build upon our results as long as it concerns an application in the digital professional workplace, and as long as the application areas, which we have determined, come into consideration. Despite these limitations, our sample is still suitable to identify and survey the application of chatbots at digital workplaces. Secondly, it could still be possible that we have not identified all tasks or application areas, as well as all objectives. Also, the combination of tasks and application areas, as well as the deduction of dependencies between the objectives are based on argumentative deductive conclusions and mentions of the participants, which must be verified in further investigations. Thirdly, different researchers might interpret the coding differently. To reduce the subjective influence during analysis, we reconciled the individual findings and merged them based on discussions between the researchers.

Even though our study focused on the application of chatbots and may have some limitations, our results seem to be generalizable and transferable to specific application areas. Based on our combination of tasks and application areas, we derived potential requirement areas. As shown in MEYER VON WOLFF ET AL. (2019a), specific requirements are still missing. Additionally, we could highlight many different objectives, which are generalizable as well. Therefore, our results can be used as a starting point for specific future chatbot implementations at a digital workplace. Practitioners, as well as researchers, can focus on our results and use the application areas and tasks as a starting point for particular requirement analysis. Moreover, based on our objectives, we could show which possible effects can be addressed with a chatbot. This can be considered in chatbot projects to evaluate possible outcomes. Additionally, practitioners and researchers can get more information about possible further effects than they initially intended.

Nonetheless, our combination of tasks and application areas, as well as the objectives and their dependencies, still have to be verified and may be extended in future research. Furthermore, as some experts mentioned supporting and hindering factors for a chatbot application, these should be addressed in detail in further research. Thus, we recommend focusing on specific application areas for which a subsequent requirements analysis must be performed. Building upon this, concrete chatbot projects or prototypes should be implemented to analyze effects and verify our underlying objectives. Also, supporting and, especially, hindering factors, e. g., challenges and their solutions, should be a subject in future research. According to MEYER VON WOLFF ET AL. (2019a), these are still open research questions of chatbot research for the digital workplace application.

2.8 Conclusion

In this research paper, we aimed at surveying relevant functions chatbots have to address at a digital workplace (*$RQ_2 1$*). Furthermore, we surveyed application areas in companies in which chatbots can be beneficial (*$RQ_2 2$*). To extend our contributions, we linked both of our results to determine the necessary tasks for each of our identified application scenarios. Additionally, we surveyed the underlying objectives and their dependencies (*$RQ_2 3$*). As a result of our interviews with 29 experts, we identified three tasks and seven application areas – along with 16 combinations – for chatbots at digital workplaces. Furthermore, we identified 15 underlying objectives – in three stages, from direct to indirect – with many dependencies between them. Therefore, our study will contribute to both research and practice: First, the study will contribute to the knowledge base and understanding of chatbots for workplaces. Thus, this can be used for further investigations in the research area. Second, we regard our tasks as a good starting point for requirement analyses for chatbot projects at digital workplaces. Therefore, we assume that the results may help when implementing chatbots as we highlight the potentials and requirements on a general level, which can be refined for respective cases.

3 State of the Practice on Influencing Factors and Challenges

Sorry, I Can't Understand You! – Influencing Factors and Challenges of Chatbots at Digital Workplaces

Sorry, I Can't Understand You! – Influencing Factors and Challenges of Chatbots at Digital Workplaces

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Abstract. Chatbot research is currently on its rise since many researchers focus on this topic from different perspectives. Thereby, the focus mostly lies on application areas that originate from business contexts. However, application areas and potential outcomes are already subject to research. The business perspective on influencing factors for an application of chatbots at workplaces or their corresponding challenges is underrepresented as less to none research exists. Therefore, we targeting this research gap by an empirical cross-section interview study with 29 domain experts for the application of chatbots at the digital workplace. We categorize the findings with an extension of the TOE-Framework and show that in the core categories of technological, organizational, individual, and environmental 11 sub-influencing factors exist. Furthermore, we also identify 36 challenges, which are relevant in the particular influencing factors.

Keywords: Chatbot · Digital workplace · Influencing factor · Challenge

1 Introduction

Currently, a new research trend emerged: the application of chatbots, which are artificial intelligence and natural language-based human-computer interfaces, to support workers and employees in their daily work [1, 2]. This trend is driven by the current progressing digitalization of society in general and the redesign of the workplace to a digitalized future workplace in specific. Established formerly paper-based working practices vanish, and more and more innovative and digital technologies are used for current daily work tasks. Therefore, almost all working tasks of employees are affected by integrating new technologies [3–6]. As a negative consequence, through the increasing use of information systems and corresponding information sources, the acquisition of information and execution of tasks is becoming obstructed. Regardless of the spread of new and smart systems, the rising information and application overload leads to an increase in the time for searching, editing, using, and sharing of information. Instead of improving work and supporting the employees, this may affect the workers' productivity negatively [6–9]. Therefore, prior research suggests providing user-centric information systems, like chatbots, to assist employees in their daily work by automating tasks or

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Keywords Chatbot, Digital Workplace, Influencing Factor, Challenge.

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Currently, a new research trend emerged: the application of chatbots, which are artificial intelligence and natural language-based human-computer interfaces, to support workers and employees in their daily work (Følstad/Brandtzæg 2017; Maedche et al. 2019). This trend is driven by the current progressing digitalization of society in general and the redesign of the workplace to a digitalized future workplace in specific. Established formerly paper-based working practices vanish, and more and more innovative and digital technologies are used for current daily work tasks. Therefore, almost all working tasks of employees are affected by integrating new technologies (Byström et al. 2017; Köffer 2015; Lestarini et al. 2015; White 2012). As a negative consequence, through the increasing use of information systems and corresponding information sources, the acquisition of information and execution of tasks is becoming obstructed. Regardless of the spread of new and smart systems, the rising information and application overload leads to an increase in the time for searching, editing, using, and sharing of information. Instead of improving work and supporting the employees, this may affect the workers' productivity negatively (Carayannopoulos 2018; Lebeuf et al. 2017; Russell 2012; White 2012). Therefore, prior research suggests providing user-centric information systems, like chatbots, to assist employees in their daily work by automating tasks or filtering and delivering only the necessary information (Følstad/Brandtzæg 2017; Richter et al. 2018). Especially for customer service, sales, or financial advisory, these systems are already being used to provide ease of use, faster, and high-quality services (Gnewuch et al. 2017). Particularly, the human-like design should contribute to a positive perception and service experience and yet offers the feeling of personal contact (Diederich et al. 2019a).

However, the current research mostly focuses on this topic through design research studies where artifacts are published, or their impact, on mostly single application areas, is evaluated (Meyer von Wolff et al. 2019a). Nonetheless, first empirical studies exist in the chatbots research domain, e.g., on trust, gender, or usability aspects. Overall, however, there is still a lot of research potential, which is due in particular to the novelty/innovativeness. In particular, the business- or management-perspective has received little or no attention so far. Especially, factors influencing or preventing adoption decisions need to be considered, as otherwise, chatbots will not be applied in business contexts, and positive results of the design studies cannot be achieved. Furthermore, the challenges of the technology should be taken into account, as these lead to efforts, which must be made during introduction and operation. Therefore, only if both influencing factors and challenges are known, they can be tackled appropriately by researchers or practice to enable and support the adoption of chatbots at digital workplaces (DePietro et al. 1990). However, to the best of our knowledge, this is so far only addressed to some extent by Rodríguez Cardona et al. (2019) for the insurance sector, and, therefore, a research gap for applications at the digital workplace.

Thus, as the initial adoption of chatbots is first of all a corporate decision instead of being based on individual intentions, we examine the issue at the business level (Egbert/Paluch 2019). We survey the hindering or supporting factors of a chatbot application at the workplace and their underlying challenges. For this, we conducted an empirical cross-section interview study with domain experts, and use an

extension of the well-established TOE framework (DePietro et al. 1990) for the categorization. In doing so, we want to assign influencing factors and challenges to the categories and assess their influences. For this research, we have oriented ourselves on the open research questions on adoption issues in MEYER VON WOLFF ET AL. (2019a), which are answered in the following:

$RQ_3 1$	Which factors influence the adoption of chatbots at digital workplaces?
$RQ_3 2$	What challenges arise when applying chatbots at digital workplaces?

The remainder of this paper is structured as follows. First, we point out related research and briefly describe the theoretical framework. Second, we present our research design and corresponding findings. Afterward, we analyze our findings and discuss them. We finish the paper with the limitations and a brief conclusion.

3.2 Related Research

3.2.1 Chatbots at Digital Workplaces

Chatbots are a special kind of information system that uses artificial intelligence and machine learning technologies to provide a natural language human-computer interface. Often the terms, conversational agent, or personal assistant are used synonymously (Bittner/Shoury 2019; Maedche et al. 2019). Users can communicate by writing or speaking with a chatbot to carry out (work) tasks or acquire information. The input is processed by natural language processing and further processed. For this, the chatbot is integrated with the enterprise systems or databases to provide the functionalities and information (Berg 2014; Mallios/Bourbakis 2016).

To date, chatbots are used in different domains, like customer support or for digital workplace tasks. However, the latter is used often nowadays but not defined commonly. Besides, the by now widely established term of knowledge work is often equated with this concept (White 2012). Based on corresponding research, we found that the characteristics of the digital workplace are tasks on information, e.g., searching, transforming, or communicating, with a high focus on information systems. Besides, the digital workplace is often location-independent and mobile. Therefore, a digital workplace is not limited to a physical place. Instead, it is a (virtual) confluence of work tasks, processes, applications systems or technologies, and people (Dery et al. 2017; Lestarini et al. 2015; White 2012). Thus, in this research, we aim at these information-intensive or knowledge work tasks instead of production processes (Rüegg-Stürm 2005).

Since the last years, different research for the application of chatbots in the different domains was published. For example, mostly prototypes, e.g., for information acquisition (Carayannopoulos 2018) or customer service (Chakrabarti/Luger 2015) were published. Furthermore, some researchers address more general or meta-level research on chatbots. To mention some, e.g., FEINE ET AL. (2019a) address the conversation between humans and chatbots and derive a taxonomy of social cues, which a chatbot should encompass. Also, researchers focus on user aspects in the context of chatbots. For example,

FØLSTAD/SKJUVE (2019) survey the user experience and motivation when using chatbots and show a general acceptance of chatbots. However, they highlight the importance of handling inquiries efficiently and adequately. A slightly different approach was presented by WUENDERLICH/PALUCH (2017) who examined factors that influence the authenticity of chatbots and, thus, influence the desired outcome like service use and quality or word of mouth. Furthermore, already some overviewing articles for application areas, technological aspects, and so on, were found in the scientific knowledge base, e.g., MAEDCHE ET AL. (2019) or SEEBER ET AL. (2019). However, despite the different approaches analyzing single aspects, an organizational level or rather a company-level survey of criteria influencing an application positively or disturbing is only barely studied (Meyer von Wolff et al. 2019a). Prior to this study, this was only carried out for the insurance sector to survey supporting or hindering adoption factors of chatbots (Rodríguez Cardona et al. 2019). Thus, a research gap is existent, which should be addressed in order to allow comprehensive research on countermeasures, or on how to successfully introduce chatbots in workplaces.

3.2.2 Theoretical Background

In today's research, different methodologies are used for the assessment of hindering or supporting factors for the application of technologies in companies. Especially, the *Technology-Organization-Environment* (TOE) framework by DEPIETRO ET AL. (1990) has often been used to identify factors affecting adoption decisions (Oliveira/Martins 2011). *Technology* factors describe internal or external technologies relevant to the company as well as the existent IT infrastructure (DePietro et al. 1990). The *organizational* factors, on the contrary, describe organizational measures like decision-making structures, size, working cultures, or readiness for IT adoptions (Rosli et al. 2012). Lastly, the *environmental* domain is the arena in which a company conducts its business like suppliers, competitors, or the government (DePietro et al. 1990). This framework was applied for example by ZHU ET AL. (2003) for assessing influencing or hindering factors of e-businesses at the firm level. Based on a survey, the authors categorized the findings along the TOE dimensions and calculated the corresponding influence of the dimension. Especially ROSLI ET AL. (2012) or AWA ET AL. (2017) are to be highlighted, where the TOE framework is extended by an *individual* (I) domain. This extension covers factors of future users or decision-makers for the adoption. Thus, these influences based on the employees or rather a user are explicitly shown in order to be addressed.

In the following, we use this extended TOIE framework to categorize the findings. In doing so, we want to identify and assess the supporting or hindering factors of chatbot applications at digital workplaces on a business level (Egbert/Paluch 2019).

3.3 Research Design

To identify influencing factors on the adoption of chatbots at digital workplaces (*$RQ_3 1$*) and underlying challenges (*$RQ_3 2$*), we conducted a qualitative empirical interview study based on MYERS (2013) and DÖRING/BORTZ (2016), and followed a three-step research process[16]:

First, we selected potential interview partners. For this, we considered managers as domain experts who deal with the future workplace design taking into account the use of natural language assistance systems like chatbots. To enrich the quality of the findings, the corresponding companies should at least plan to use chatbots or develop them on their own, e.g., software firms. Besides, the experts should already have at least a few years of working practice. To ensure heterogeneity and to achieve a comprehensive cross-section for the research area, we did not limit the industry sector or the company size. By doing so, we want to attain generalizable results, which can be easily reused in further research. Based on the criteria and personal contacts or internet searches, we contacted 68 experts via e-mail of whom 29 experts participated in 27 interview cases (see Table 27).

Case	Expert	Industry	Case	Expert	Industry
01	01	ICT	15	16	ICT
02	02	ICT	16	17	Other manufacturing
03	03	Automotive Engineering	17	18	Other services
04	04	Automotive Engineering	18	19	Finance & Insurance
05	05	ICT	19	20	Other services
06	06	Other services	20	21	ICT
07	07	Finance & Insurance	21	22	ICT
08	08	ICT	22	23	ICT
09	09	Finance & Insurance	23	24	ICT
10	10	Finance & Insurance	24	25 & 26	ICT
11	11	ICT	25	27	Other services
12	12	ICT	26	28	ICT
13	13 & 14	Pharmaceuticals	27	29	Finance & Insurance
14	15	Raw Materials			

Table 27 Description of the Experts participated in Study III

Second, we conducted the interviews face-to-face or via conference systems during a four-month period. We used a semi-structured interview guideline[17] as a basis to be able to leave enough room for own ideas or experts' opinions. According to the theoretical saturation (Glaser/Strauss 2006), we stopped the process as we could not reveal new insights. The interviews were recorded and transcribed if our privacy policy was accepted.

Third, we coded and analyzed our 27 interview cases using a structured content analysis approach. The coding was done by two researchers independently using continuous analysis of the transcripts followed by a discussion and an assignment of the codes to the core topics (*$RQ_3 1$* and *$R_3 Q2$*) (Mayring 2014).

[16] This is a further segment of the overarching initial interview study. Thus, the description coincides with the one from Study II (see Section 3A2.3).

[17] See Appendix A3.2 for the complete semi-structured interview guideline of the overarching empirical interview study.

Lastly, we used the TOIE framework for categorization and assigned the identified factors and challenges. As the interviews were conducted in German, we translated the final coding into English while preserving the meaning.

3.4 Findings

Based on the described research design, we coded 597 quotes and statements for the core categories in the 27 interview case transcripts. According to the *Technology-Organizational-Individual-Environment* framework of ROSLI ET AL. (2012) and AWA ET AL. (2017), we classified the influencing factors or challenges as technological, organizational, individual, and environmental. Based on the 27 cases, we identified 11 influencing factors (F_Xi) along with corresponding 36 challenges ($C_Xi.j.$) for the adoption and operation of chatbots at digital workplaces (see Figure 20), which we describe afterward. In the following, the numbers are related to the interview cases instead of the experts. An overview of the influencing factors and the challenges, along with exemplary quotes from the interviews, is available in Appendix A3.4.[18]

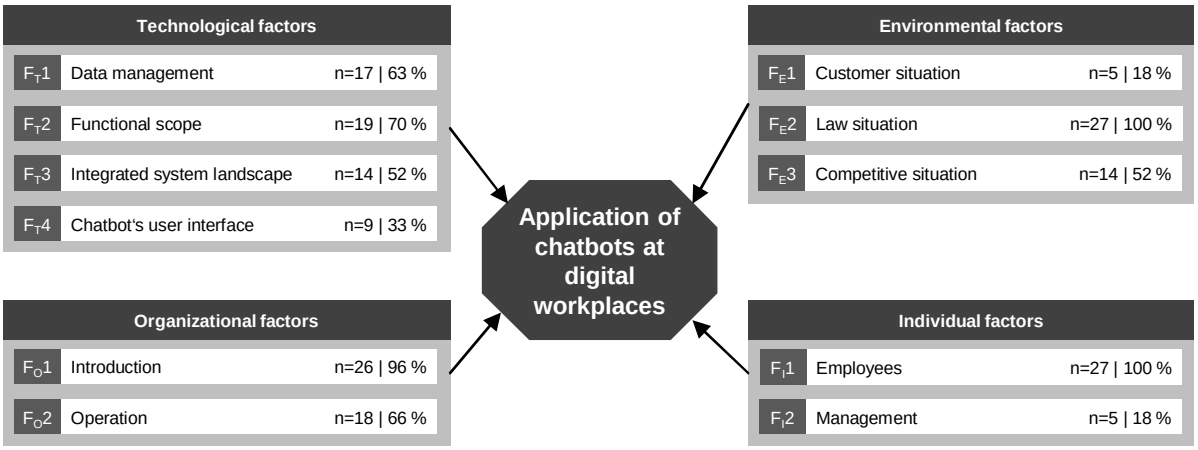


Figure 20 Identified Chatbots' Influencing Factors

3.4.1 Technological Factors

We identified four technological influencing factors and corresponding challenges (see Table 28). These represent characteristics of the technology or the enterprise system landscape, which have to be considered for the adoption of chatbots.

The first influencing factor for a chatbot application is the existing **data management** [F_T1] in businesses. In particular, the participants specified that a structured knowledge and data infrastructure that can be accessed via interfaces, which are designed for natural language, is necessary so that the chatbot can use them to generate statements. However, besides these interfaces, especially the creation of the knowledge base is associated with challenges, as existing information is in an inappropriate form or even non-existing [$C_T1.1$]. Additionally, as the chatbot grows over time, further challenges arise for the continuous training and maintenance of the underlying data. Particularly in the

[18] In the published version, reference was made to the online appendix at *http://bit.ly/CBInfC*.

customer support area, another challenge arises. As noted by the experts, problems exist when the chatbot statements are not coherent with the statements of real employees, e.g., when the datasets are not up to date or otherwise adulterated [C_T1.2]. As users only write or speak with the chatbot, they trust that the chatbot will provide correct information and may not be able to identify incorrect information. This can also refer to organizational issues and factors. Otherwise, acceptance problems or legal effects could be the consequence.

In addition to the data management, the chatbot's **functional scope** [F_T2] is also an influencing factor, which was named by most of the experts. Typically, chatbots answer questions or carry out work tasks (Meyer von Wolff et al. 2020a). For this, they must understand the natural language inputs, provide the requested functions, and execute actions correctly. In doing so, a challenge exists since currently all conversation paths must be defined in advance [C_T2.1]. Despite the claim of artificial intelligence, the functionality is only as extensive as it was implemented before. Chatbots often fail with the mapping of dynamic, volatile processes [C_T2.2]. As a solution to be capable of this kind of conversation, usually, the perpetuation of context is recommended. However, preserving the context over several dialog changes is a challenge for current implementations [C_T2.3]. A further challenge arises along with the functional scope: the understanding of expressions or, rather, the localization effort [C_T2.4]. As mentioned by the participants, particularly in large companies, many different nationalities, languages, or even just dialects must be taken into account when designing or implementing a chatbot for the employee or customer support. Currently, a chatbot still has to be trained for every single language individually. The corresponding language understanding problems also include, e.g., synonyms or colloquial language, as well as emotions or other forms of rhetoric like irony or sarcasm.

Furthermore, we identified an **integrated system landscape** [F_T3] as necessary for a chatbot operation. In order to deliver answers or perform tasks, chatbots must access existing databases and systems. Also, chatbots must be integrated with the available information systems so that not only another system is provided. As mentioned by our experts, both of these are current challenges during implementation. First, many of the available databases or information systems have no appropriate natural language-capable interfaces to integrate the existing, often hierarchical grown, landscape with the new technology. Therefore, application programming interfaces have to be developed and also maintained during the operation of chatbots [C_T3.1], which becomes more critical the deeper a chatbot is to be integrated into the landscape. Second, chatbots must be integrated into the user interfaces of available information systems, i.e., that users can access the chatbot from the existing information system. Especially for already existing communication tools, this integration must be pursued. As mentioned by some participants, they assess it as critical that a chatbot can be used through these systems [C_T3.2].

A last technological factor is the **chatbots' user interface** [F_T4] or respectively, their setup tools. Chatbots have to be developed, trained, and regularly improved via tools and systems dependent on the used technology or manufacturer. As quoted by the experts, these are challenges in chatbot realizations [C_T4.1]. Current interfaces or tools for chatbots' management are mostly accessible only to technically skilled employees – easy-to-use administration interfaces for non-technical employees are missing. Therefore, employees who have the best knowledge of the specific application area, e.g., support staff who has daily conversations with customers, cannot directly contribute to the necessary

information, questions, or answers. Sometimes, the essential interfaces or tools are absent completely, so all of the content have to be programmed manually. Furthermore, the user interface of chatbots states a second challenge. Based on the one-dimensional characteristics of a chat dialog, it is hard to map complex processes with multidimensional paths or returns. Instead, the content that can be displayed mostly comprises (short) texts, pictures, or videos as well as some control elements [C_T4.2].

		Technological Challenges	*n*
F_T1	**C_T1.1**	Provision and maintenance of the required (knowledge) database	16
	C_T1.2	The coherence of the statements of a chatbot and real (service) employee	1
F_T2	**C_T2.1**	All (conversation-)paths must be defined in advance	4
	C_T2.2	Mapping of dynamic, volatile processes or conversations	8
	C_T2.3	Preserving the conversation context in the conversation process	5
	C_T2.4	Problems with language understanding and effort for language localization	11
F_T3	**C_T3.1**	Data and process integration with existing information systems and/or databases	12
	C_T3.2	Integration into user interfaces of existing information systems and/or interfaces	5
F_T4	**C_T4.1**	Inappropriate tools for creating and maintaining chatbots	2
	C_T4.2	Restrictions and limitations within the user interface	9

***Note**: Counts based on the 27 interview cases*

Table 28 Technological Challenges

3.4.2 Organizational Factors

Our study revealed two organizational influencing factors. These represent aspects and decisions that have to be made or considered prior to the acquisition of chatbots, as well as issues to consider during a productive operation in digital workplace scenarios (see Table 29).

The first influencing factor of the organizational dimension is the successful **introduction** [F_O1]. At the time of the survey, some of the companies have not implemented a strategy or agenda taking into account the application of chatbots (in the workplace) [C_O1.1]. Instead, investments are made in other technologies. Therefore, the chatbot projects are often driven by single responsible persons or departments, which makes coordination among the different projects difficult and partly leads to redundant developments. Additionally, even if the potential of chatbots is often proclaimed, a missing added-value is reported [C_O1.2], which also affects user acceptance as in the individual factors. Therefore, value-adding use cases must be identified beforehand [C_O1.3]. There is a variety of possible use cases, but not in every case, a chatbot is the best fit. Instead, classical user interfaces are sometimes a better choice. Thus, as a first step in chatbot projects, suitable use cases must be selected, e.g., as pointed out in MEYER VON WOLFF ET AL. (2020a), and following differentiated and defined to address beneficial tasks. Critical is that present processes often cannot be mapped one-to-one by chatbots [C_O1.4]. Instead, the current processes must be redefined and adjusted to the natural language user interface and the conversational operation. In addition, the scalability of chatbots is a crucial factor, which includes an easy transfer of established instantiations to new use cases as well as finding use cases where high volumes of questions are existent for automated answering [C_O1.5]. Otherwise, a chatbot only causes costs instead of cost savings. Additionally, a chatbot must be customized and personalized to the application area, as well as to the individual company. Therefore, this is often a time-consuming and cost-intensive process [C_O1.6]. Due to this resulting expense and technological

requirements, it is often not feasible for small companies. Extending this, all content the chatbot provides is mainly based on the departments' knowledge, e.g., customer support. Therefore, the departments' employees, e.g., first-level support staff, are required for creating the knowledge base of the chatbot [C_O1.7]. However, these employees should be relieved, or rather the chatbot should take over some of their tasks. Thus, this could lead to some resistance, as employees are afraid of becoming replaceable if they contribute their knowledge completely. Lastly, it is also necessary to integrate the works council in the projects. As mentioned, obstacles can occur thereby since personal data is recorded or can be linked by the system [C_O1.8]. Especially, the free text input is prone to entering personal or not anonymous data by mistake. Concerning this, the workers' council should be involved from the start, and agreements should be signed.

As a second influencing factor, the participants noted the continuous **operation** [F_O2] of a chatbot. For this, our participants mentioned a high effort for continuous maintenance and training [C_O2.1]. This is necessary to adjust the system and to take previously unaddressed or misunderstood questions into account as shown in the technological factors. Otherwise, user acceptance or usage suffers from it. However, automated training is also critical in this context, as there is sometimes the problem that incorrect contexts or answers are learned. Therefore, additional monitoring has to be introduced. A further challenge arises with responsibilities for the training and maintenance, which are often missing in the companies [C_O2.2]. The necessary steps after implementing a chatbot are not allocated probably. Sometimes these steps are outsourced, which, however, can result in dependencies or data privacy/security problems as described in the environmental factors. Lastly, as noted by one participant, the danger of knowledge loss is existent [C_O2.3]. If all tasks are operated only by a chatbot, no employee has the knowledge to take them over.

		Organizational Challenges	*n*
F_O1	**C_O1.1**	Lack of an agenda for chatbots	5
	C_O1.2	Missing of an added-value	17
	C_O1.3	Definition and design of use cases	16
	C_O1.4	Existing (business processes) processes cannot be mapped by chatbots	2
	C_O1.5	Scalability of chatbots	6
	C_O1.6	Creating chatbots is time-consuming and cost-intensive	14
	C_O1.7	Generation of content for chatbots from the different departments	3
	C_O1.8	Obstacles by the works council	10
F_O2	**C_O2.1**	Extensive maintenance and continuous training of chatbots in the company	18
	C_O2.2	Missing responsibilities for chatbots	4
	C_O2.3	Risk of know-how loss in the company	1

***Note**: Counts based on the 27 interview cases*

Table 29 Organizational Challenges

3.4.3 Individual Factors

In addition, we identified two individual influencing factors and their challenges (see Table 30). These address the future users of chatbots in a respective company, e.g., the employees, as well as the management staff who is responsible for the provision of resources.

One of the most noted influencing factors for a successful chatbot application are **employees** [F_I1]. As pointed out by our participants, employees often have exaggerated expectations of chatbot capabilities. Mainly due to current advertisements, they assume that all possible questions could be answered [$C_I1.1$]. Despite these high expectations, we found evidence for acceptance problems for this new kind of information system [$C_I1.2$]. On the one hand, especially long-term employees do not see the benefit of an application change, because they have to adapt to new ways of working and forget the familiar. On the other hand, driven by the intended automation and relief, employees perceive chatbots as a threat to their employment [$C_I1.3$]. For all of these three challenges, it is advisable to establish change or rather expectation management. As a result of this, the added value can be demonstrated, and fears can be overcome, e.g., new duties instead of job losses. Furthermore, besides the acceptance, currently, the users lack of experience with chatbots or rather the technology behind them. During acquisition, necessary components, as well as the operating principles, are unknown [$C_I1.4$]. During operation, this results in users not knowing how to work with the systems, since they only know the interaction through classic UI's. The situation is intensified by the fact that users have to adapt to the syntax and the dialog structure [$C_I1.5$]. The latter leads to a more difficult and unnecessarily longer execution time, which also harms acceptance. Some participants also mentioned emerging irritations, when chatbots are not recognizable as a chatbot [$C_I1.6$]. The last critical point is that acceptance is negatively affected when chatbots do not provide help after a certain time [$C_I1.7$]. In these cases, the inquiring person should be forwarded to a real employee.

A further individual influencing factor is the **management** [F_I2] of the respective company. Some of the participating experts criticized that the management has a sternly or inadequate assessment of the required effort [$C_I2.1$]. Instead, the assumption dominates that a chatbot can be provided without much effort. So they do not see what additional work needs to be done, e.g., an adaption of existing processes, integration into the landscape, continuous training, or necessary change management in the company. Besides, management support starts to fade after the initial investment [$C_I2.2$]. Instead, the management is often only interested in results, which leads to no further resources being provided.

		Individual Challenges	*n*
F_I1	**$C_I1.1$**	Overestimation and high expectations of employees	15
	$C_I1.2$	Acceptance problems of users for chatbots	20
	$C_I1.3$	Fear of job loss	10
	$C_I1.4$	Lack of experience with chatbots or the technology behind	8
	$C_I1.5$	Adapt to the syntax and the dialog structure	7
	$C_I1.6$	Irritation when not recognizing chatbots immediately	5
	$C_I1.7$	Dissatisfaction due to lack of assistance	9
F_I2	**$C_I2.1$**	Misjudgment of the effort of chatbot projects	3
	$C_I2.2$	Loss of management support during the project	3

***Note**: Counts based on the 27 interview cases*

Table 30 Individual Challenges

3.4.4 Environmental Factors

Lastly, we identified three environmental influencing factors and their challenges (see Table 31) for the application of chatbots at workplaces. These concerns both, customers as well as legal or competitive situations with which the company is confronted.

Our participants mentioned the **customer situation** [F_E1] of the respective company to be considered as necessary. The application of chatbots, especially in customer-oriented operations, can influence the external perception of the company. If, for example, a service chatbot breaks down and no employees are available, customer inquiries cannot be answered. Besides, the risk evolves that customers fell low esteemed by the impersonal contact over a chatbot. Both factors result in the challenge of customer loss [$C_E1.1$] as well as impersonal communication [$C_E1.2$]. Especially the external application of chatbots is critical since customers would more likely change the company as opposed to employees who would only complain internally.

In addition to the customer situation, the current **law situation** was pointed out in all interviews. Besides the protection of personal data [$C_E2.1$], the data must also be stored securely [$C_E2.2$]. This especially concerns a chatbot application in Europe, as the general data protection regulation (GDPR) must be considered. For proper operation, it is necessary to clarify data processing and storing as well as establish policies. A further solution is the anonymization of inputs. However, technology measures often fail to identify information worth protecting or are complex to implement. Despite all the measures, risks remain. Especially the free text input is prone to entering personal or not anonymous data by mistake, e.g., accidentally free text inputs of private or company-related information. Therefore, a current strategy is the in-house operation of chatbots. Although the data remains in the company, the question arises if a technological lead can be kept or the higher costs justify this.

The last identified influencing factor states the **competitive situation** [F_E3] of the respective company. Most experts pointed out an innovation pressure for chatbots caused by the current hype about artificial intelligence technologies in general and of first-level support chatbots in specific [$C_E3.1$]. Often, chatbot projects are just wanted or implemented without a suitable use case. Instead, the focus lies only on keeping up with competitors. In addition, dependencies with chatbot providers arise [$C_E3.2$]. Companies struggle with the selection of an appropriate provider. Besides choosing an interface that is used by the users, companies must select a corresponding long-term provider. Critical is that the selection is difficult to undo since current chatbot instantiations cannot be easily transferred to another provider or a different chatbot platform. Especially, since it is unclear which suppliers will be active in the long term.

		Environmental Challenges	*n*
F_E1	**$C_E1.1$**	Loss of customers	3
	$C_E1.2$	Impersonal customer contact	3
F_E2	**$C_E2.1$**	Ensuring data protection (concerning GDPR)	27
	$C_E2.2$	Ensuring data security	12
F_E3	**$C_E3.1$**	Innovation pressure to use chatbots	12
	$C_E3.2$	Dependencies on the provider of chatbot technology	5

***Note**: Counts based on the 27 interview cases*

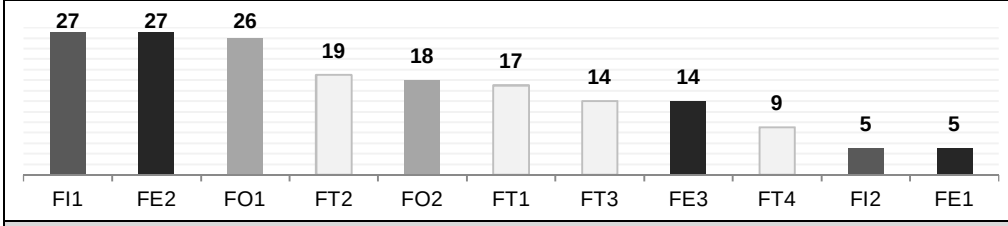
Table 31 Environmental Challenges

3.5 Analysis and Discussion

Our findings imply that there exist many influencing factors and challenges, corresponding to the TOIE framework by ROSLI ET AL. (2012) when applying chatbots at digital workplace settings. This also underlines the capability of the TOIE framework for identifying influencing factors and challenges on a business level. Furthermore, although the primary goal was a qualitative study to identify factors and challenges that influence adoption, we have extended the results quantitatively based on the 27 interview cases to assess their influences. This helps in identifying critical factors, which should be addressed as well as in prioritizing countermeasures. For this, we summed up the unique number of cases in which they were mentioned.

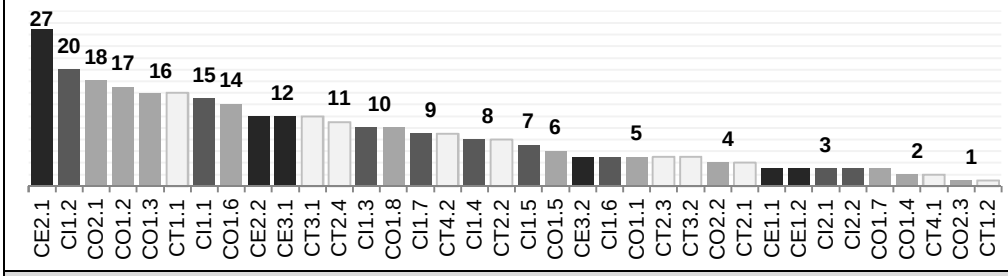
Overall, we identified 11 influencing factors (see Table 32). Mostly, in all cases (*n*=27) the *employees* [F_I1] and the *law situation* [F_E2] were noted followed by 26 cases that stated the *introduction* [F_O1] as critical for a successful chatbot application. The *management* [F_I2] and the *customer situation* [F_E1] cause less impact, as mentioned by only 5 experts. The technological influencing factors are mentioned moderately by 9 to 19 experts. In addition, we surveyed challenges, which are existent in each influencing factor, and identified 36 of them. Mostly the challenge of *ensuring data protection* [$C_E2.1$], especially under consideration of GDPR, was named in all of the cases. The subsequently named challenges are *acceptance problems* [$C_I1.2$] (*n*=20), *extensive maintenance and continuous training of chatbots* [$C_O2.1$] (*n*=18), and a *missing benefit* [$C_O1.2$] (*n*=17). The first technological challenge, the p*rovision and maintenance of the required (knowledge) database* [$C_T1.1$], is named in the fifth place by 16 experts. The least named challenges are *inappropriate tools for creating and maintaining chatbots* [$C_T4.1$] and *existing (business) processes that are not aligned to chatb*ots [$C_O1.4$] in two cases, as well as *the coherence of the statements of a chatbot and real employees* [$C_T1.2$] and *risks of know-how loss* [$C_O2.3$] in one case. Thus, two technological challenges are among these, which support the hypothesis that technical aspects are not the problem when applying or operating chatbots in businesses. Furthermore, mostly technological influencing factors are named (see Table 32). This indicates that currently, technical aspects are present, or the focus lies on them. In the case of the mean of mentions, however, the organizational influencing factors are mentioned much more frequently (*mean*=22). Whereas, the technological factors are the least named (*mean*=14,75). This distribution is also recognizable for the challenges: Besides the organizational challenges, which are 11 in total, 10 technological challenges were identified. However, on average, our experts mostly stated environmental challenges (*mean*=10,33) followed by individual challenges (*mean*=8,89). Therefore, we conclude that: (1) In the case of influencing factors, mostly the organizational factors must be taken into account when applying chatbots in workplaces settings. (2) In the case of challenges, mostly environmental challenges must be considered and addressed to enable a purposeful application of chatbots. (3) In summary, although chatbots are a technology, there are rather organizational, external, or individual aspects, which should be considered foremost. Nonetheless, as we value the influence based on the number of mentions, this does not necessarily mean that the others are not critical. Instead, they also have the potential to be a showstopper and must be taken into account likewise.

Influencing factors



	technological	organizational	individual	environmental
∑ (Influencing factors)	**4**	2	2	3
$\bar{X}$ (Mentions of influencing factors)	14,75	**22**	16	15,33

Challenges



	technological	organizational	individual	environmental
∑ (Challenges)	10	**11**	9	6
$\bar{X}$ (Mentions of challenges)	7,3	8,73	8,89	**10,33**

Table 32 Distributions of Influencing Factors and Challenges

Thus, the results of the study affirmed our initial assumption that the research community should switch from chatbot design research to rather an organizational or management view. As shown, technical aspects are mentioned less. On the contrary, organizational and individual issues have the highest influence on adoption decisions, as well as environmental or individual challenges. Nonetheless, as the design research perspective is often pursued and the identified factors influence individual design decisions, our results should be included in future design research studies for chatbots in business applications. In doing so, possible challenges can be addressed and the corresponding effects can be reduced early in the design stage or in design studies. Additionally, it is also noticeable that many classic IT influencing factors or challenges also apply in particular for chatbot applications at digital workplaces, e.g., data protection, user acceptance, or maintenance and support of the systems.

Furthermore, we could find some clues that related research can be verified by our findings. At first, our study verifies the high influence of the user on introduction and operation. Secondly, we could derive high expectations of the users, pointed out by KRAUS ET AL. (2019) or RZEPKA (2019). Additionally, LAUMER ET AL. (2019a) show that environmental and individual factors have a high relevance on adoption decisions, which we were also able to show. Thus, we could contribute that users and usability factors have a high influence on the adoption of chatbots in workplace settings. Although chatbots are technically easy to set up, the major effort concerns the design of social and human aspects to enable an intuitive and natural usage behavior. Also, from a theoretical perspective, many of our individual factors, e.g., *overestimation and high expectation* [C_I1.1], or *lack of experience* [C_I1.4], can be mapped to the core constructs of technology acceptance and their theories, e.g., TAM or UTAUT (Davis 1993; Venkatesh et al. 2016). Thus, future studies could pursue these approaches in detail. Also, general

aspects of system quality were mentioned, e.g., the *syntax* [C_I1.5] or *security* [C_E2.1, C_E2.2.], which is consistent with IS success research and underlines the importance of these characteristics during chatbot application (DeLone/McLean 2003). In comparison to previous results focusing the environmental issues, we also show that especially data protection and data security are challenging factors when applying chatbots at digital workplaces (e.g., Pumplun et al. 2019). As this category is also our most noted challenge factor, future studies should focus more on these issues. Especially in comparison to the study of RODRÍGUEZ CARDONA ET AL. (2019), we enrich the knowledge base with specific and comprehensive specifications of influencing factors and their respective challenges for the workplace domain. Furthermore, we could verify the artificial intelligence research agenda of BAWACK ET AL. (2019), who already pointed out people, (inter-)organizational and societal issues, as relevant for future research.

3.6 Conclusion and Limitations

In this research paper, we survey influencing factors (*$RQ_3$1*) and challenges (*$RQ_3$2*) for the application of chatbots at digital workplaces. Based on the TOIE framework, we identified technical, organizational, individual, and environmental influencing factors and challenges. As our results indicate, the participants note mostly the organizational influencing factors as opposed to the challenges, where mostly the external ones were mentioned. Comprehensively, we show that despite chatbots being a (new) technology, mostly the non-technical aspects should be taken into account.

However, as with every qualitative study, there exist some limitations, which have to be outlined. First, the findings and results are significantly dependent on the interviewee selection and their willingness to participate and provide insights into their experiences. We minimized this influence by: (1) Including a suitably large set of participants with knowledge for the application of chatbots at digital workplaces. (2) Taking into account a cross-section of the industry to achieve generalizable results and to weaken the impact of individual areas. However, our sample consists predominantly of German participants. Second, the primary goal was a qualitative study. Nonetheless, we also did some quantitative evaluations based on our interviews. As these sums are only based on our sample, the findings are not representative. Hence, the distribution can be seen as a first indicator of a weighting of factors and challenges when applying chatbots at digital workplaces. Third, different researchers might interpret the findings differently. Therefore, we analyzed the interviews by two researchers independently followed by a discussion between them where the findings were merged.

Despite these limitations, our results seem to be comprehensive and generalizable. Thus, with our findings, we contribute to both, research and practice. For the scientific community, firstly, we close the existent research gap for influencing factors and challenges surrounding the chatbot application at digital workplaces. Secondly, we confirm the previous results in this research topic and extend them through our comprehensive survey. Furthermore, we show that especially organizational or management, as well as environmental topics, should be followed in future research. These topics have been given less consideration to date, and our assessment confirms the importance of the factors. For the practice community, we point out comprehensively influencing factors and challenges. Companies can use them

for a successful chatbot application. Second, with our influencing factors, decision-makers can prioritize their tasks and address them based on our descriptions and the weighting. Nonetheless, the results still have the potential to be verified on a larger scale, e.g., internationally or in other industries.

B Research Complex: Design of Chatbot Applications for the Digital Workplace

To benefit from the potential of chatbots to support employees at digital workplaces by providing a natural and intuitive user interface that can be used without further training, the actual application of chatbots must be examined. Therefore, research complex B builds upon the results on the state of the art and practice by providing insights and design recommendations for chatbot applications at the digital workplace. Consequently, the research question on which research complex B is based addresses the design of chatbots in business contexts [MRQ2]. The research question is subdivided into four sub-meta research questions [MRQ2.1-4] (see Table 2) addressing the four areas of interest for designing chatbots in business contexts.

First, research complex B examines the design requirements for chatbots in business contexts and how chatbots should be designed [MRQ2.1]. For this, the sub-meta research question is refined by four research questions of three independent studies (see Figure 21). First, the results of Study I and Study II show that information acquisition is a viable application area, which is also the basis of many research studies to date. However, as pointed out in Study I, requirements for information acquisition chatbots are missing. Therefore, in Study IV this topic is addressed by surveying both the technical requirements for information acquisition chatbots [$RQ_4 1$], and the content-related requirements [$RQ_4 2$] based on a questionnaire study among possible future users of a respective chatbot (Meyer von Wolff et al. 2020b). In addition, Study V addresses this question by designing an IT-support chatbot, which is a possible application area according to the first studies, based on common design recommendations and taking into account an actual support scenario at a German university [RQ_5] (Meyer von Wolff et al. 2020d). Both Study IV and Study V took place in a university context and differ from the company perspective. However, in both studies, typical tasks that also occur in the workplace were addressed, as students sooner or later become employees in companies and can therefore provide insight regarding inexperienced employees. Lastly, Study I outlines that chatbots are suitable for information acquisition tasks, which has been investigated extensively up to now, especially by design studies. However, business processes also play a decisive role in employees' daily work. Study I and Study II already pointed out the viability of chatbots for self-service tasks at digital workplaces. Consequently, as this has hardly been investigated by science so far, Study VI focuses on the design of a process-based chatbot in the business context based on a *Design Science Research* study (Hevner et al. 2004; Hevner 2007) using a business travel organization process as an example [$RQ_6 1$] (Meyer von Wolff et al. Forthcoming). In doing so, the general suitability of chatbots for business processes should be examined based on the example, without following the goal of replacing the corresponding process. Additionally, the design recommendations and results of Study V are also considered as a pre-test for the design of the process-based chatbot in Study VI.

Second, for the design, the users' perspective must be considered directly as they are using the chatbot in their daily work life, and the success depends largely on their acceptance and usage [MRQ2.2]. The corresponding sub-meta research question is refined by two further research questions in two studies.

Therefore, Study V addresses this by an evaluation with possible future users, i.e., students, on how they assess the concept of chatbot-based IT-support [RQ_5] (Meyer von Wolff et al. 2020d). For this, the evaluation addresses the chatbots' language understanding, the influence of visualization and control elements, and the overall user experience. Study VI examines the users' perspective via an evaluation of a process-based chatbot with 69 participants [RQ_62] (Meyer von Wolff et al. Forthcoming). In addition to the general design and user experience, the users' acceptance is surveyed based on the *Technology Acceptance Model* (Davis 1993) and the *Information System Success Model* (DeLone/McLean 2003).

Third, to evaluate the suitability of chatbot applications from an organizational perspective, their impact on the digital workplace, and the generated business value should be surveyed [MRQ2.3]. This sub-meta research question is addressed by Study VI [RQ_63] (Meyer von Wolff et al. Forthcoming). In doing so and based on the experimental evaluation with 69 participants, it is examined how the process-based chatbot is able to execute the exemplary business process. The focus is on the process lead times and the process quality in terms of error probability.

Fourth, to make the results reusable, so that chatbots can be developed for other and deviating business scenarios or processes, it is necessary to generalize the findings [MRQ2.4]. For this purpose, a *Nascent Design Theory* is constructed in Study VI [RQ_61] (Meyer von Wolff et al. Forthcoming). In doing so, the results of the three research questions of Study VI were summarized by deriving the generalized theory that can be used and adapted for creating new process-based chatbots in business contexts to support employees in their daily work.

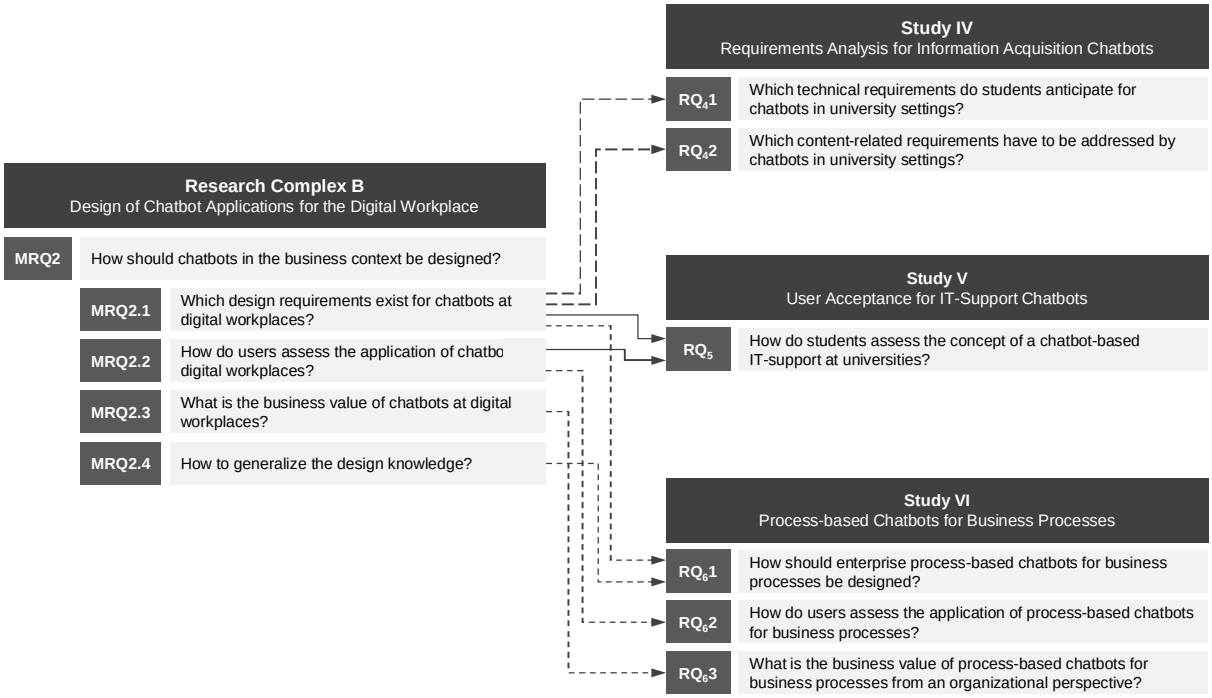


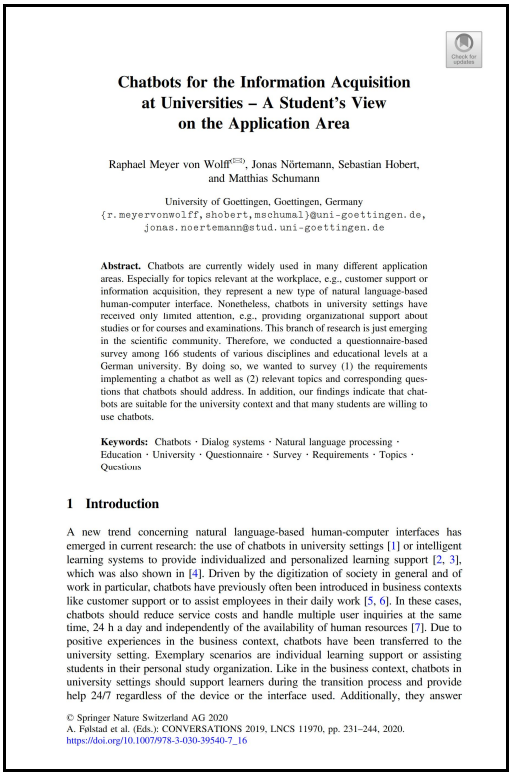
Figure 21 Overview of the Studies and their Research Questions of Research Complex B

Supplementary information for the studies is provided in the appendix. This encompasses the original online questionnaire of Study IV in Appendix A4. In Appendix A5, the three evaluation scenarios and the questionnaire of Study V are outlined. Appendix A6 includes a brief overview for the requirement analysis, the industry distribution of the experts of the evaluation, the two evaluation scenarios, the

questionnaire both as an overview with the references and as the actual instantiation, and the structured interview guideline for the evaluation with the experts. Some further detailed results for the user experience evaluation and the acceptance evaluation are also given.

4 Requirements Analysis for Information Acquisition Chatbots

> Chatbots for the Information Acquisition at Universities – A Student's View on the Application Area



Chatbots for the Information Acquisition at Universities – A Student's View on the Application Area

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Abstract. Chatbots are currently widely used in many different application areas. Especially for topics relevant at the workplace, e.g., customer support or information acquisition, they represent a new type of natural language-based human-computer interface. Nonetheless, chatbots in university settings have received only limited attention, e.g., providing organizational support about studies or for courses and examinations. This branch of research is just emerging in the scientific community. Therefore, we conducted a questionnaire-based survey among 166 students of various disciplines and educational levels at a German university. By doing so, we wanted to survey (1) the requirements implementing a chatbot as well as (2) relevant topics and corresponding questions that chatbots should address. In addition, our findings indicate that chatbots are suitable for the university context and that many students are willing to use chatbots.

Keywords: Chatbots · Dialog systems · Natural language processing · Education · University · Questionnaire · Survey · Requirements · Topics · Questions

1 Introduction

A new trend concerning natural language-based human-computer interfaces has emerged in current research: the use of chatbots in university settings [1] or intelligent learning systems to provide individualized and personalized learning support [2, 3], which was also shown in [4]. Driven by the digitization of society in general and of work in particular, chatbots have previously often been introduced in business contexts like customer support or to assist employees in their daily work [5, 6]. In these cases, chatbots should reduce service costs and handle multiple user inquiries at the same time, 24 h a day and independently of the availability of human resources [7]. Due to positive experiences in the business context, chatbots have been transferred to the university setting. Exemplary scenarios are individual learning support or assisting students in their personal study organization. Like in the business context, chatbots in university settings should support learners during the transition process and provide help 24/7 regardless of the device or the interface used. Additionally, they answer

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Keywords Chatbots, Dialog Systems, Natural Language Processing, Education, University, Questionnaire, Survey, Requirements, Topics, Questions.

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4.1 Introduction

A new trend concerning natural language-based human-computer interfaces has emerged in current research: the use of chatbots in university settings (Carayannopoulos 2018) or intelligent learning systems to provide individualized and personalized learning support (Hobert/Meyer von Wolff 2019; Winkler/Söllner 2018), which was also shown in MEYER VON WOLFF ET AL. (2019a). Driven by the digitization of society in general and of work in particular, chatbots have previously often been introduced in business contexts like customer support or to assist employees in their daily work (Følstad/Brandtzæg 2017; Reshmi/Balakrishnan 2016). In these cases, chatbots should reduce service costs and handle multiple user inquiries at the same time, 24 hours a day, and independently of the availability of human resources (Ranoliya et al. 2017). Due to positive experiences in the business context, chatbots have been transferred to the university setting. Exemplary scenarios are individual learning support or assisting students in their personal study organization. Like in the business context, chatbots in university settings should support learners during the transition process and provide help 24/7 regardless of the device or the interface used. Additionally, they answer individual questions regardless of whether particular university terms are used or concrete university-specific questions are raised (Carayannopoulos 2018).

Even though some research on chatbots exists in educational settings, there is, to the best of our knowledge, currently no consideration of actual student requirements for a university chatbot for FAQ-like questions (Meyer von Wolff et al. 2019a). Prior research studies often only focus on particular use cases and designing corresponding chatbots. However, the results of these first studies promise positive outcomes for a university application. Therefore, as a starting point, first instantiations of university chatbots should address the provision of organizational information based on FAQs to evaluate the acceptance and general requirements at first. In prior research, first studies already investigated this by developing different chatbots for university settings (Carayannopoulos 2018; Shawar et al. 2005). Therefore, we aim at surveying the actual student's demands to provide a meaningful chatbot. Thus, the aim of our study is (1) to identify technical requirements for chatbots, and (2) to explore topics and related exemplary questions that should be answered by chatbots in a university setting. Based on an empirical questionnaire study among students at a German university, we address the following research questions:

RQ_41	Which technical requirements do students anticipate for chatbots in university settings?
RQ_42	Which content-related requirements have to be addressed by chatbots in university settings?

To answer these questions, the remainder of this article is structured as follows. Next, we briefly point out related research in Section 3B4.2. Afterward, we describe the research design in Section 3B4.3 and present our findings in Section 3B4.4. We complete our article with a discussion of the results in Section 3B4.5 and a brief conclusion in Section 3B4.6.

4.2 Background

4.2.1 Chatbot Basics

In general, a chatbot is an application system that provides a natural language user interface for the human-computer interaction. It usually uses artificial intelligence and integrates multiple (enterprise) data sources (like databases or applications) to automate tasks or assist users in their (work) activities (Meyer von Wolff et al. 2019b).

Usually, the chatbot's architecture is composed of three components that are used via the human-computer interface (see Figure 22): (1) The *natural language processing*, which is responsible for (a) processing the user input – audio or text – into a machine-readable form by analyzing, dismantling and pattern extracting, as well as (b) generating a natural language output corresponding to the results of the dialog manager. (2) The *dialog manager,* which matches the user input against integrated backend systems and extracts content or executes functions. (3) The *backend*, which contains all relevant application systems or databases that are required for the desired application area in order to be able to process the user request (Meyer von Wolff et al. 2019a).

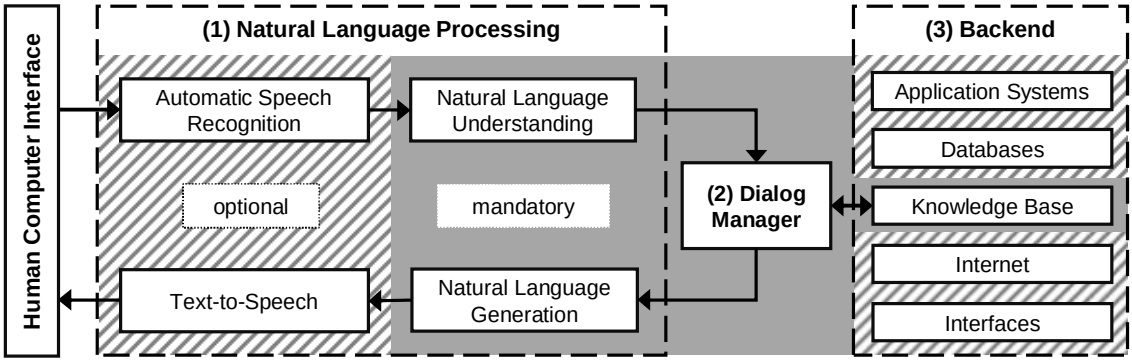


Figure 22 The Architecture of a Chatbot

4.2.2 Chatbots in University Settings

Currently, chatbot research receives a lot of interest, and many researchers focus on this research topic from different perspectives. As shown in MEYER VON WOLFF ET AL. (2019a) and MAEDCHE ET AL. (2019), chatbot research mainly focuses on the application areas of customer support (Wuenderlich/Paluch 2017), information acquisition (Al-Zubaide/Issa 2011) as well as on business processes (Gyton/Jeffsry 2017). For university settings or rather educational scenarios, chatbot research is just beginning. To date, different studies and research streams are pursued:

In a recent literature review, HOBERT/MEYER VON WOLFF (2019) surveyed the current state of the art for pedagogical conversational agents. As shown in the publication, a trend for designing messenger-like chatbots has been identified. Further results of the analysis are that the current literature lacks on generalizable results. In a similar study, WINKLER/SÖLLNER (2018) also conducted a literature review. The authors show that educational chatbot research is just in its beginnings, with a suggested potential for this application area. However, they note that the efficiency strongly depends on the individual

student requirements, the way the chatbot is built, and the process quality. Those results confirm the need for surveying requirements for chatbots in universities.

Extending this, some studies have already presented first concepts and prototypes in this field of research. For instance, MIKIC FONTE ET AL. (2009b) developed an intelligent tutoring system capable of providing learning content and a possible assessment of the student through the dialog. MIKIC FONTE ET AL. (2009a) conducted a similar study in order to provide course content and a question-based assessment using a chatbot. In CARAYANNOPOULOS (2018), a chatbot for information acquisition in universities was presented. The chatbot can respond to students' inquiries about upcoming events or courses, leisure activities, or pending tasks. Additionally, SHAWAR ET AL. (2005) and SHAWAR (2008) describe an FAQ chatbot in a university setting. In SHAWAR (2008), an extension with preprocessed and stored online available FAQs is shown. Both chatbots generate the answers either on a complete match or on a match based on the first or second most significant word. Additionally, RANOLIYA ET AL. (2017) examine university FAQs by developing a concept for a corresponding chatbot. Furthermore, FENG ET AL. (2018) provide a concept for a Q&A chatbot that is capable of answering student questions in a natural way and of creating an efficient learning environment. HIEN ET AL. (2018) conducted an empirical study to examine the requirements of a university chatbot for answering students' questions. The derived requirements are also conceptualized. Finally, ALLISON (2012) surveyed the application of chatbots in libraries. With the presented chatbot, students can get answers on services or available resources of a library.

To sum up, and as shown in MEYER VON WOLFF ET AL. (2019a), one critical aspect of the current state of scientific knowledge is the lack of coverage of the design science process in general. In many cases, only particular phases are addressed. The investigation of specific requirements for selected use cases is missing. Only HIEN ET AL. (2018) followed a similar approach to survey the actual students' requirements for providing a meaningful chatbot. Therefore, as stated earlier, it would be best if, as a starting point, real-case requirements are collected from future users in order to provide a meaningful chatbot in a university setting.

4.3 Research Design

To identify students' technical requirements in university settings (RQ_41) as well as content-related requirements (RQ_42), i.e., topics and questions to be addressed, we conducted a questionnaire survey among students at a German university. For this purpose, our study followed a three-step process:

First, we created a questionnaire based on previous findings (Meyer von Wolff et al. 2019a; Meyer von Wolff et al. 2019b) comprising qualitative and quantitative questions. After a short introduction of the research project, which included a definition of chatbots to ensure clear understanding (see Section 3B4.2), questions – categorized in three sections – were interrogated: (1) general questions about the participant, (2) questions about the current or previous procedure of the students to acquire information and their satisfaction with it; and (3) questions about their experience and valuation of chatbots as well as topics to support and issues to answer. Before the data collection, we did a pilot test with multiple research associates who already had experience in questionnaire studies. Following, we

rephrased some questions and added further questions for assessing a university chatbot and the target platforms. An overview of the final questionnaire is depicted in Table 33.[19]

Section	Question	Type
1: Questions about participants	Gender	quantitative
	Field of study	quantitative
	Targeted degree	quantitative
	Current semester	quantitative
2: Questions about information acquisition and satisfaction	How have you proceeded so far when you had questions?	quantitative
	How satisfied are you with the current opportunities to receive information?	quantitative
	What would you improve/change in current methods of information retrieval?	qualitative
3: Questions about chatbots	Have you already had experiences with chatbots?	quantitative
	For what tasks? / Why not?	qualitative
	On what topics should a chatbot be able to give you information?	qualitative
	What questions would you ask a chatbot at the university?	qualitative
	How would you rate the following characteristics of a chatbot?	quantitative
	How would you rate a university chatbot for information retrieval?	quantitative
	For which platforms/devices should a chatbot be provided?	quantitative

Table 33 Questionnaire Structure of Study IV

Second, we conducted the survey within a two-week timeframe in June 2019. Therefore, we announced the survey in different lectures, among student assistants as well as through social media postings, e.g., on Facebook, which was shared in several university groups as well. Overall, 530 students accessed the questionnaire, of which 214 students participated (40 %). After cleaning the dataset of invalid data entries, we used 166 data sets (31 %) for further analysis. Overall, the processing time for each student took 2 to 13 min (*mean*=6:30 min).

Third, we analyzed the datasets in two ways. For this purpose, we evaluated the quantitative data with spreadsheet programs. The qualitative data on topics and questions were categorized independently by two researchers on the subject and finally merged during a subsequent joint verification.

4.4 Survey Results

In the following, we present the results of our study. Therefore, we first show the sample description (Section 3B4.4.1). Afterward, we highlight the technical (RQ_41) and content-related requirements (RQ_42) in Section 3B4.4.2 and Section 3B4.4.3. Lastly, a short usefulness assessment is presented in Section 3B4.4.4.

4.4.1 Sample Description

Our study sample (*n*=166) consists of mostly male students (58 %), followed by 36 % of female students. Nine participants have not answered the question.

[19] See Appendix A4 for the applied questionnaire.

We mainly acquired bachelor students (*n*=87; 52 %) followed by master students (*n*=58; 35 %). Additionally, some participants target a doctoral (*n*=4), a state examination (*n*=6), or other (*n*=6) degrees. Five participants have not answered the question.

Most participants are in their first four semesters: 38 % in the first two (*n*=63) and 37 % in the following two semesters (*n*=61). Also, 25 % of the participants (*n*=15) are in a higher semester (7th semester or greater). Thus, students from all graduation levels and all semesters participated.

For the distribution of the subject area, we aimed at a cross-section among all students from our university. Therefore, we tried to acquire students from all available fields of study. Our participant group consists mostly of economic science students (*n*=102; 61 %). The following fields of study have a much lower proportion: 16 from mathematics and computer science, 13 from agricultural and forestry science as well as humanities and cultural science, 11 from natural science as well as social science, 9 from teaching professions, 7 from law, as well as 3 from theology and 2 from medical science. Additionally, the students were able to make multiple entries for their field of study. Therefore, economics science is overrepresented (*n*=102). This might be explained since we teach in this area and mainly approach students via our lectures. Nevertheless, economic science consists of subgroups that are, in addition, different from each other. Nonetheless, we were still able to acquire participants from all disciplines, at least.

We also measured the actual experience of the participants with chatbots in general (see Figure 23). Most of our participants (41 %) already use chatbots at least on an occasional basis. On the downside, 34 % of the students have not used a chatbot at all. Among these, ten participants stated that they have privacy concerns, e.g., "*Where they are used, I have concerns about privacy*" or "*permanent possibility of interception*". In addition, nine participants rated the use as too cumbersome or had problems with the chatbot functions, e.g., "*Slow, a lot of unnecessary communication, no good answers, answers too inaccurate, writing often more complex than clicking, etc.*", "*Chatbots are good for basic information that you can usually find on the website anyway*", or "*I find information as a list better*". In contrast, 17 participants stated that there are no reasons against using chatbots. Up to now, no situation has emerged, e.g., "*It has not yet happened, there is nothing against it*" or "N*othing, rather this has advantages, like a permanent availability*". Based on this, we conclude that many students already use chatbots or are willing to use them. Nevertheless, more than half of the students (*n*=107; 65 %) have already made first or more extensive experiences with chatbots. Thus, frequent use of the technology, also outside the university context, has already been identified.

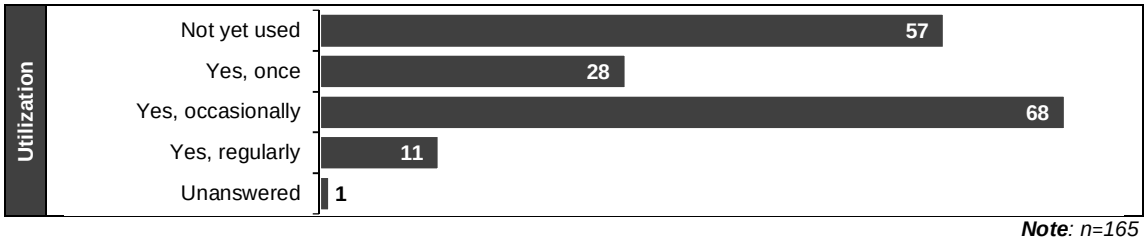
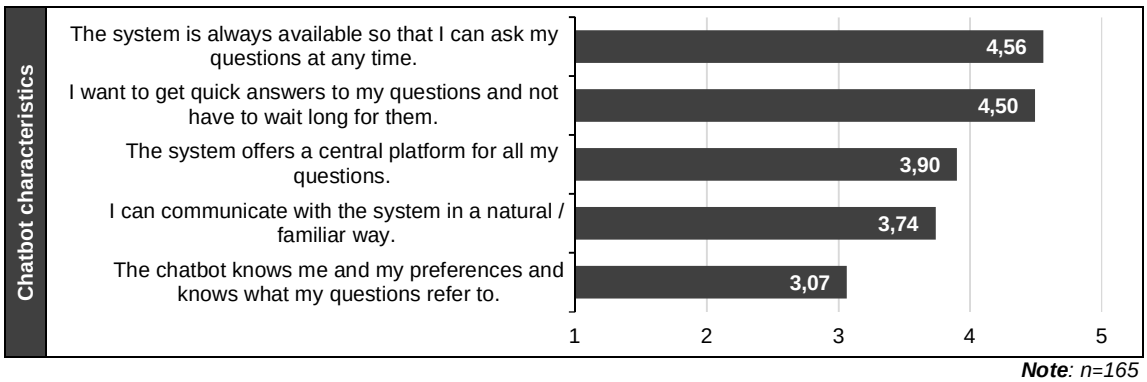


Figure 23 Frequency of Previous Usage

4.4.2 Technical Requirements

Based on the questionnaire, we first analyzed basic technical requirements for a chatbot application in a university context (*RQ4.1*).

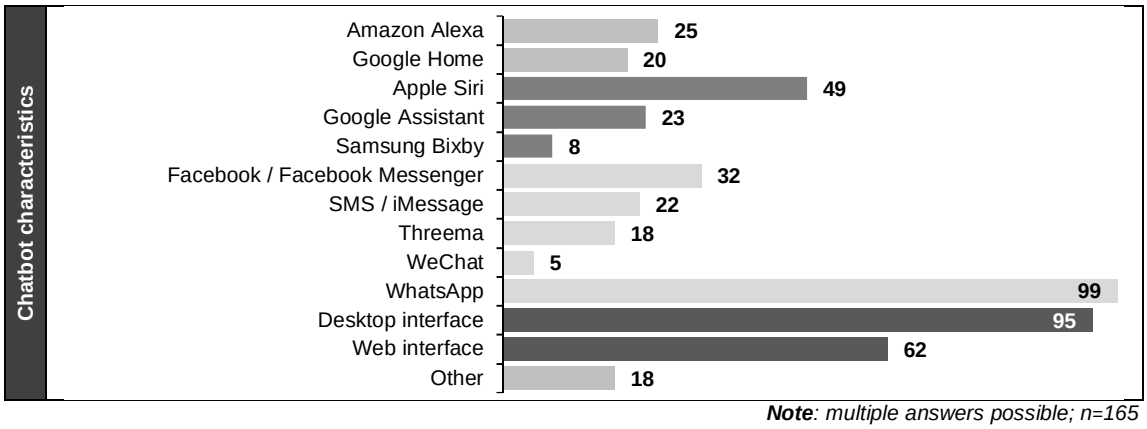
Therefore in the first question, we asked the students about the characteristics of chatbots (Meyer von Wolff et al. 2019a) by means of a 5-point Likert scale (1: unimportant; 5: very crucial) (see Figure 24). Based on the results, it is clearly shown that most students prefer the *24-hours-a-day availability*. Therefore, they do not have to wait until human contact persons are available. In addition, the participants appreciate the *fast response time* combined with the direct assistance for the question that has arisen. Also, we have identified that the chatbot's ability to *respond individually to the user* is not considered very important by users. Nonetheless, our participants rated all the characteristics as above average. Therefore, these should be addressed in potential university chatbots.



***Note**: n=165*

Figure 24 Means of Chatbot Characteristics

In a second question, we asked the participants for the chatbot operation platform (see Figure 25). According to the students, the most relevant platforms for university chatbots are mostly *WhatsApp* or *desktop and web interfaces*. Whereas the former is difficult to implement due to the infrastructure and the specifications, the latter two are easier to realize. Among the *other*-category, we identified mostly Telegram (*n*=9) but also XMPP or own apps as well as chatbots integrated into the university portals. Nonetheless, our selection options are not entirely free of overlaps; we could highlight the relevant platforms. Above all, chatbots should be integrated into the interfaces used by students on a daily basis. Due to the many selected platforms, it would be best if a chatbot were not limited to a specific platform. Instead, it should be possible to make a request from all platforms.

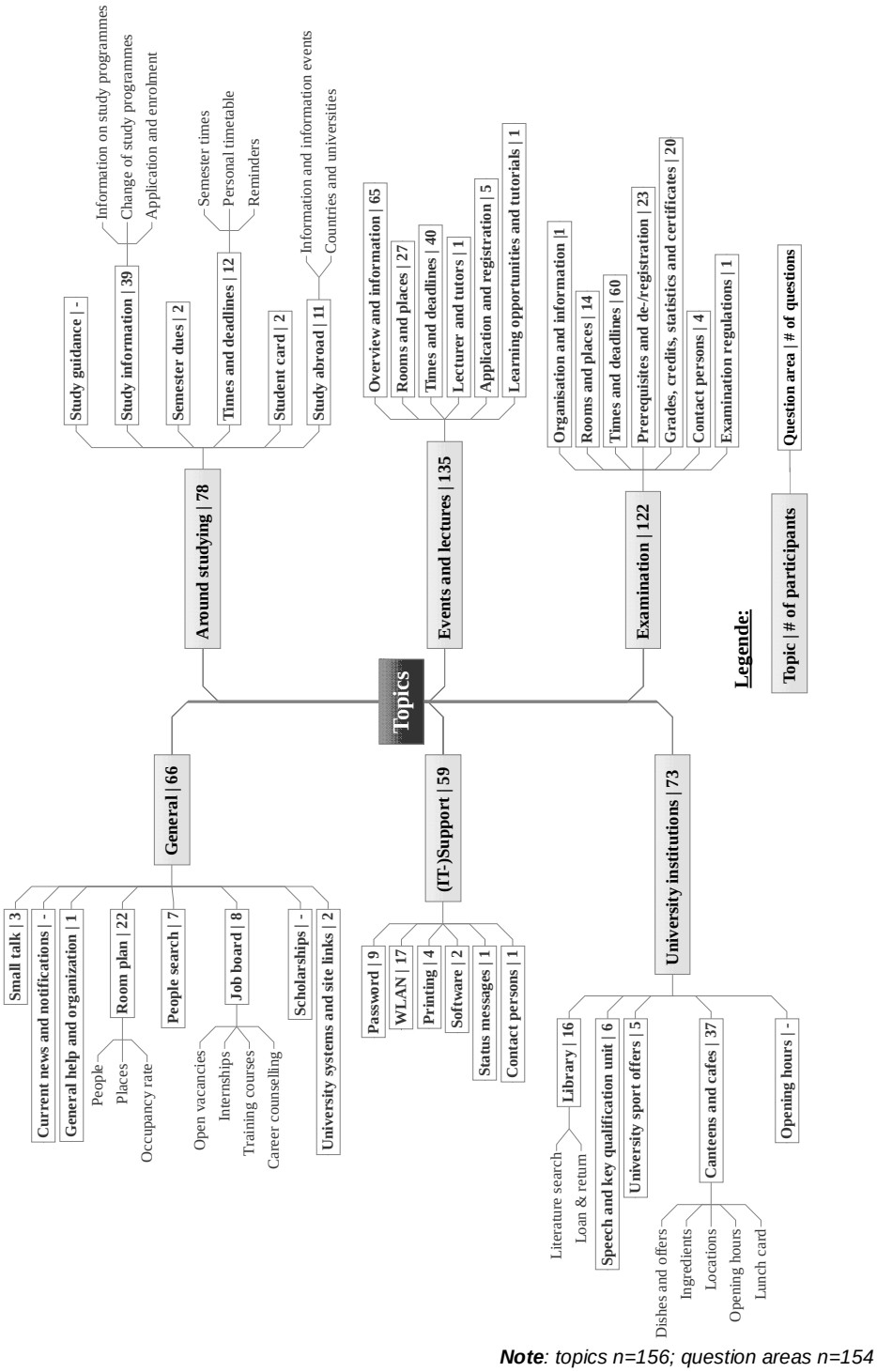


***Note**: multiple answers possible; n=165*

Figure 25 Target Platforms for University Chatbots

4.4.3 Content-related Requirements

Furthermore, we identified content-related requirements in the sense of topics to be addressed or questions to be answered by a chatbot in a university setting (*RQ42*). Based on two open questions in the questionnaire, the participants were asked about short topic mentions and exemplary questions that we categorized afterward. In total, we acquired 503 statements concerning topics and 495 exemplary questions as a starting point. Following the categorization process, we jointly merged them into 36 question sections, partial with sub-sections, in six core topics for a university chatbot for students. A complete overview of the categorization is displayed in Figure 26.



***Note**: topics n=156; question areas n=154*

Figure 26 Categorization of Topics and Question Areas for University Chatbots

As shown, chatbots in university settings should address the topic of **information around studying** in general. At first, students would use a chatbot when looking for study programs or gathering information about the university in general. Also, some organizational issues should be answered like semester dues or times, as well as those regarding studying abroad. Second, the application area of chatbots for (upcoming) **events and lectures** seems interesting. A chatbot provides the content of the offered courses and their dates and times or locations, as well as the responsible persons. In addition to events and lectures, a chatbot should provide support for **examination**-related questions. Similar to the previous category, information on the examination in general, as well as the room and date, are highly relevant. Moreover, organizational issues like regulations, contact persons, as well as information on prerequisites and how to register should be covered. Furthermore, the participants would inquire (personal) statistics or retrieve/request their certificates. Another application area, which should be taken into account in university settings, is the closely related **institutions or departments**. In our study, the participants noted the library, canteens and cafes, or the sports offers. These institutions and departments should be extended or adapted to the respective university so that students can obtain information on opening hours; food offers in the canteen, and so on. Furthermore, university chatbots should provide basic **(IT-)support**. As our participants specified, they want help with the WLAN or printer setup, when password matters occur, as well as with the provision of software provided by the university. Lastly, we identified some different **general** concerns relevant to chatbots in a university setting. This includes, for example, small talk and university news. Also, general room plans or people's search should be provided in the form of an information desk. Additionally, the participants would like to have a job board to inquire about open vacancies or possible internships, and so on.

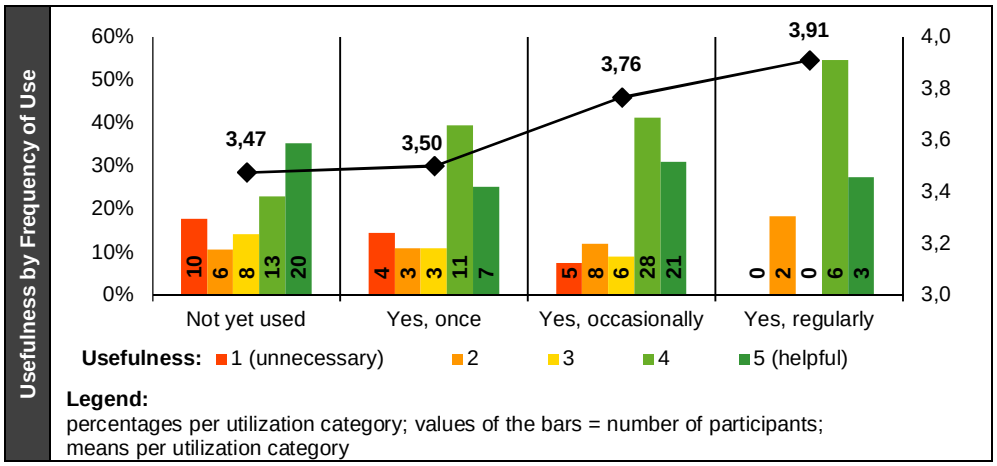
Overall, as the most-mentioned topic, the students voted for a chatbot that can answer questions regarding *events or lectures* (*n*=135) or for *examination-related information* (*n*=122). Even if only indicated by fewer participants, *information around the study program* (*n*=78), the *university institutions* (*n*=73), or the *(IT-)support* (*n*=59) are potential topic areas for a university chatbot. Therefore, first instances, or, rather extensions to existing implementations should definitely address the two most mentioned topic areas if they have not yet been considered. Furthermore, in terms of questions, those two topic areas have most of the questions given by the participants. Out of this, we infer that students have had the most questions regarding these areas so far, as they have cited many concrete example questions.

In the case of questions, we gathered mostly questions regarding the overview and information for events and lectures (65 questions), e.g., "*Which modules are offered for the subject this semester?*", "*Which contents should be taught during the lecture/seminar?*". In addition, questions about times or deadlines for examination (60 questions), e.g., "*When does the exam take place?*", "*Until when can I unsubscribe for the exam?*" or for events and lectures (40 questions), e.g., "*Does the lecture take place on Wednesday?*", "*When in the week does the module take place?*" were given. Furthermore, we collected some sub-topics with no corresponding questions, e.g., current news and notifications, scholarships, general opening hours, or study guidance. As these sub-topics were stated by the students as potential topics, questions should be developed in order to be able to address these issues in the future.

It should be mentioned that many of the question areas show reciprocal dependency, e.g., questions for contact persons in general and examinations, or times and deadlines in nearly all topics. These highlight relationships to be mapped in implementations or, rather, in the knowledge base.

4.4.4 Usefulness Assessment

To underline the usefulness of chatbots, we also asked the participants about their assessment of the application of the technology in university contexts (see Figure 27).



Note: *n=164*

Figure 27 Evaluation of Usefulness by Frequency of Use

Based on a 5-point Likert scale (1: unnecessary; 5: helpful), we wanted to know how the students would rate it if a chatbot were available at our university. Overall, the participants rated this with an average of 3,62, which means a tendency to be helpful could be derived. In a more detailed analysis based on the frequency of usage (see Figure 23), an interesting trend could be identified. Our results show that the more often a student used chatbots before, the higher the average rating of usefulness is. Even if only a few students regularly use chatbots, they have the highest average rating for usefulness. In addition, in the group of students who have not used chatbots until now, the highest count for helpfulness could be measured. However, this could also point out an exaggerated expectation for chatbot technology. Furthermore, this group also has a nearly balanced distribution of usefulness. In addition, the more often chatbots are used, the more specific the distribution is in terms of helpfulness.

4.5 Discussion

Based on our students' questionnaire survey, we identified which technical requirements in the form of characteristics and target platform (RQ_41), as well as content-related requirements in the form of topics and questions (RQ_42), are most important.

Our findings show that a chatbot is highly relevant for the application in a university context, as many topics and questions arose, for which a chatbot is usable. Additionally, 65 % of the students participating in our study have already had some initial experiences with the technology. However, many of the participants (35 %) have not used a chatbot so far, of whom 30 % of the participants, in principle, have nothing against usage. This is also shown in Section 3B4.4.4 as the participants who have not yet used

chatbots rate the helpfulness highest. Overall, the students rated chatbots as helpful. Independently of prior experience, the average rating of all groups described in Figure 27 is above the mean. Thus, we identified a positive attitude of the participants towards chatbots in university settings, which is also shown in HIEN ET AL. (2018).

Additionally, we asked the participants to rate the essential chatbot characteristics. As a result, the following characteristics were rated as most important: *24/7 availability*, *fast and direct response* as well as acting as a *central platform* for information acquisition. Surprisingly, our participants rated the ability to *respond personally* to the user or previous conversations as the lowest. This is in contrast to the current purposes of the scientific community, e.g., (Følstad/Brandtzæg 2017; Hien et al. 2018). Even though we do not have further information on this topic, a reason could be that the participants regard a university chatbot mostly as a tool to provide simple and general organizational information around *lectures and events*, which is shown in Section 3B4.4.3. In doing so, non-personalized information or content is delivered. However, the second most named category is the *examination* that requires personalization in order to provide a reasonable answer, e.g., to provide certificates or to respond with personal exam dates. Thus, we identified an inconsistency among our results.

Regarding the target platforms, even if all options were selected, a focus on *WhatsApp*, *Siri*, and *desktop or web interfaces* could be determined. Thus, for the design of a university chatbot, they should be supported. However, this indicates a much more important requirement: the use of a chatbot from different channels, depending on the available device at the time of need. This can also be derived from the characteristics, as a chatbot mostly provides an appropriate answer 24/7 and in a timely manner. For the design, this means that a university chatbot should be programmed openly or should have corresponding interfaces, e.g., as a web application. Additionally, the high mentions for *WhatsApp* or *Siri* could hint at a further design requirement: audio or spoken inputs, as they are being used commonly nowadays on these platforms.

As a further result of the analysis, we identified *university events and lectures* as well as *examinations* as the most relevant topics to be addressed by a university chatbot. Furthermore, most of the collected questions aim at locations, definitions of content, or dates and can be answered with short sentences. Mostly, these questions are rather task-oriented or pertain to organizational issues for educational concerns but do not focus on education via a chatbot. This can be a hint regarding the expectations of chatbot users and may underline the basic abilities that the technology must fulfill: providing short answers or, rather, solutions for organizational issues in the sense of FAQs whenever needed. Surprisingly, individual learning support or providing lecture content were not mentioned by the participants at all. Maybe our participants only think about their previous experiences with different chatbots and try to transfer this knowledge to the university setting. However, this contradicts the current research approach, which focuses mostly on chatbot-mediated education. Nonetheless, for universities, as surveyed in this study, a chatbot should primarily provide organizational issues around lectures or examinations. This is also reflected partially in the survey conducted by HIEN ET AL. (2018).

As with every empirical study, there exist some limitations that need to be discussed. Firstly, the findings of our study are mainly dependent on the students' responses and their willingness to participate.

Therefore, we have tried to maximize the reach in order to acquire as many participants as possible. We have not limited the disciplines or other aspects to survey a cross-section in the research area. However, the sector of economics science is overrepresented, but we were still able to acquire at least a few students from all disciplines. Despite this, our sample is still suited to indicate the technical and content-related requirements. Secondly, based on the chosen research design in the questionnaire form, maybe some questions were misunderstood by some participants. We tried to mitigate this by conducting a pretest before the actual survey. Thirdly, our derived design requirements are only based on the findings as well as on argumentative deductive conclusions. Therefore, these should be implemented in a prototypical chatbot so that they can be evaluated in real case scenarios.

Even though our study focused on the student's perspective on the application of chatbots in university settings and may have some limitations, our results seem to be valuable and useful for future applications of chatbots at universities. Based on our findings, we could highlight necessary platforms and characteristics as well as topics and areas of questions, which have to be addressed in the first instances. Nonetheless, our findings have to be verified in real case scenarios. For this purpose, chatbots should be set up with the help of our results. Afterward, the usefulness of chatbots should be evaluated in order to identify gaps in the knowledge base and to be able to assess the use of the technology in university settings or other educational contexts.

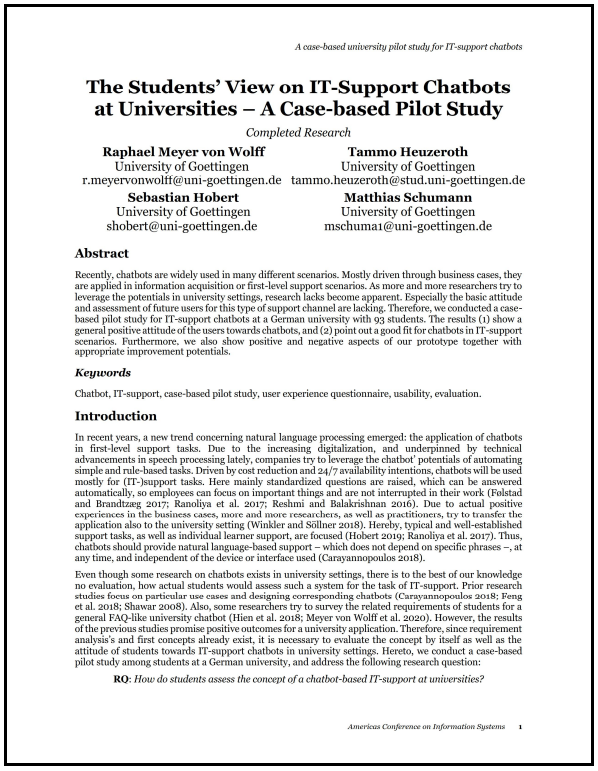
4.6 Conclusion

In this research paper, we aimed at surveying the application of chatbots in university settings. We questioned our students concerning their technical requirements (*RQ_41*) as well as topics and areas of questions (*RQ_42*) that a chatbot should address. As a result of our 166 participants, we could derive that the characteristics of *24/7 availability* and *fast solutions*, as well as *WhatsApp* or *desktop user interfaces* as target platforms, are most important. In addition, we identified six core topics along with 36 question areas, of which *events and lectures*, as well as *examinations*, are especially important.

These can be used as a starting base for future implementations. Therefore, our study can contribute to the knowledge base and the understanding of chatbots used in university settings in two ways: (1) as a starting point for implementations or prototypes for the specific area of universities or rather education, as well as (2) for further investigations in this research area in general, e.g., requirement analysis or acceptance studies among future users.

5 User Acceptance for IT-Support Chatbots

The Students' View on IT-Support Chatbots at Universities – A Case-based Pilot Study



A case-based university pilot study for IT-support chatbots

The Students' View on IT-Support Chatbots at Universities – A Case-based Pilot Study

Completed Research

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Abstract

Recently, chatbots are widely used in many different scenarios. Mostly driven through business cases, they are applied in information acquisition or first-level support scenarios. As more and more researchers try to leverage the potentials in university settings, research lacks become apparent. Especially the basic attitude and assessment of future users for this type of support channel are lacking. Therefore, we conducted a case-based pilot study for IT-support chatbots at a German university with 93 students. The results (1) show a general positive attitude of the users towards chatbots, and (2) point out a good fit for chatbots in IT-support scenarios. Furthermore, we also show positive and negative aspects of our prototype together with appropriate improvement potentials.

Keywords

Chatbot, IT-support, case-based pilot study, user experience questionnaire, usability, evaluation.

Introduction

In recent years, a new trend concerning natural language processing emerged: the application of chatbots in first-level support tasks. Due to the increasing digitalization, and underpinned by technical advancements in speech processing lately, companies try to leverage the chatbot' potentials of automating simple and rule-based tasks. Driven by cost reduction and 24/7 availability intentions, chatbots will be used mostly for (IT-)support tasks. Here mainly standardized questions are raised, which can be answered automatically, so employees can focus on important things and are not interrupted in their work (Følstad and Brandtzæg 2017; Ranoliya et al. 2017; Reshmi and Balakrishnan 2016). Due to actual positive experiences in the business cases, more and more researchers, as well as practitioners, try to transfer the application also to the university setting (Winkler and Söllner 2018). Hereby, typical and well-established support tasks, as well as individual learner support, are focused (Hobert 2019; Ranoliya et al. 2017). Thus, chatbots should provide natural language-based support – which does not depend on specific phrases –, at any time, and independent of the device or interface used (Carayannopoulos 2018).

Even though some research on chatbots exists in university settings, there is to the best of our knowledge no evaluation, how actual students would assess such a system for the task of IT-support. Prior research studies focus on particular use cases and designing corresponding chatbots (Carayannopoulos 2018; Feng et al. 2018; Shawar 2008). Also, some researchers try to survey the related requirements of students for a general FAQ-like university chatbot (Hien et al. 2018; Meyer von Wolff et al. 2020). However, the results of the previous studies promise positive outcomes for a university application. Therefore, since requirement analysis's and first concepts already exist, it is necessary to evaluate the concept by itself as well as the attitude of students towards IT-support chatbots in university settings. Hereto, we conduct a case-based pilot study among students at a German university, and address the following research question:

RQ: *How do students assess the concept of a chatbot-based IT-support at universities?*

Americas Conference on Information Systems 1

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5.1 Introduction

In recent years, a new trend concerning natural language processing emerged: the application of chatbots in first-level support tasks. Due to the increasing digitalization, and underpinned by technical advancements in speech processing lately, companies try to leverage the chatbots' potential of automating simple and rule-based tasks. Driven by cost reduction and 24/7 availability intentions, chatbots will be used mostly for (IT-)support tasks. Here mainly standardized questions are raised, which can be answered automatically, so employees can focus on important things and are not interrupted in their work (Følstad/Brandtzæg 2017; Ranoliya et al. 2017; Reshmi/Balakrishnan 2016). Due to actual positive experiences in the business cases, more and more researchers, as well as practitioners, try to transfer the application also to the university setting (Winkler/Söllner 2018). In doing so, typical and well-established support tasks, as well as individual learner support, are focused (Hobert 2019b; Ranoliya et al. 2017). Thus, chatbots should provide natural language-based support – which does not depend on specific phrases –, at any time, and independent of the device or interface used (Carayannopoulos 2018).

Even though some research on chatbots exists in university settings, there is to the best of our knowledge no evaluation on how actual students would assess such a system for the task of IT-support. Prior research studies focus on particular use cases and designing corresponding chatbots (Carayannopoulos 2018; Feng et al. 2018; Shawar 2008). Also, some researchers try to survey the related requirements of students for a general FAQ-like university chatbot (Hien et al. 2018; Meyer von Wolff et al. 2020b). However, the results of the previous studies promise positive outcomes for a university application. Therefore, since requirement analyses and first concepts already exist, it is necessary to evaluate the concept by itself as well as the attitude of students towards IT-support chatbots in university settings. Thus, we conduct a case-based pilot study among students at a German university, and address the following research question:

RQ_5	How do students assess the concept of a chatbot-based IT-support at universities?

To answer these questions, we first briefly outline the theoretical foundations and related research. Next, we describe the case scenario, the study design, and the resulting chatbot prototype. Hereafter, we present our findings. We finish our paper with a discussion of the results and a brief conclusion.

5.2 Theoretical Foundation

In general, chatbot research is a re-emerging research trend in the last years (Meyer von Wolff et al. 2019a). By providing a natural language user interface, users can communicate naturally and intuitively through a dialog to retrieve information, or execute (business) functions. Chatbots use artificial intelligence and integrate available and relevant application systems and databases. The focus lies thereby on automating tasks, supporting employees, reducing information overload, and assisting users

in their (daily work) activities to enhance productivity (Angga et al. 2015; Carayannopoulos 2018; Maedche et al. 2019).

In specific, chatbot research receives a lot of interest as much research focuses on this topic from different perspectives. Besides some publications focusing on the state of the art (e.g., Feng/Buxmann 2020; Maedche et al. 2019; Meyer von Wolff et al. 2019a), mostly prototypes are developed for different application areas. Especially, the domain of natural language-based information acquisition revived attention so far (e.g., Carayannopoulos 2018; Reshmi/Balakrishnan 2016). Specifically for university-related information acquisition, MIKIC FONTE ET AL. (2009b) developed an intelligent tutoring system to provide students with learning content as well as possible assessments of the learned content through the dialog. In CARAYANNOPOULOS (2018) also a chatbot for information acquisition at universities is described, which can respond to inquiries about events, courses, leisure activities, or actual tasks. Also, SHAWAR (2008) presents a chatbot concept that uses preprocessed online available FAQs. Based either on a complete match or a match based on the first or second most significant word, the relevant answers are displayed. Especially, university FAQs are also addressed by the chatbot of RANOLIYA ET AL. (2017). Additionally, FENG ET AL. (2018) provide a concept for a chatbot that can answer students' questions in a natural way while creating an efficient learning environment as well. Besides these concepts and prototypes, some researchers focus on general aspects of information acquisition. For example, HIEN ET AL. (2018), as well as MEYER VON WOLFF ET AL. (2020b), try to analyze and survey the specific requirements of students belonging to the chatbot-based information acquisition at universities. Also, aspects of user experience and acceptance, as well as usability for chatbot applications, and so on, are surveyed, (e.g., Følstad/Skjuve 2019; Wuenderlich/Paluch 2017). Additionally, GO/SUNDAR (2019) or FEINE ET AL. (2019a) surveyed aspects of humanlike chatbots, like anthropomorphism, visual cues, or contingent message exchanges. Likewise, LIEBRECHT/VAN HOOIJDONK (2020) examine human response behaviors as a requirement when designing chatbots or chatbot dialogs. However, the actual attitude of future users is often not addressed in the current research. Instead, the chatbots or their effects are evaluated after they are deployed. Therefore, a research gap around the attitude and acceptance prior to deployment or operation is existent, which should be addressed to achieve more successful chatbot operations from the beginning.

5.3 Case Description

In this paper, we survey the case of a German university's IT service department, whose offerings are grown historically. Besides classical phone or e-mail support as well as personal on-site support, a wiki software is provided as a starting point for help (see Figure 28, left). This wiki covers mostly typical emerging questions as well as instructions for individual topics relating to the university's important student systems and technical aspects around the university, e.g., WLAN setup, mail access, user account, and so on.

However, the current approach shows a number of problems. With personal support via phone, e-mail, or onsite inquirer will certainly get a personalized answer and the correct solution. On the downside, the problem is that service quality depends strongly on the availability of well-trained employees. Also, often

standard questions are asked, which can be answered with a consistent response. As a result, the employees are occupied with answering these frequently asked questions with always the same answers, which leads both to interruptions in their flow of work and dissatisfaction due to the repetitive, boring work. Further, employees cannot focus on complicated questions or have no time for them. In addition, support depends on business hours and available employees. Thus, students cannot get help 24/7. With the available wiki software, the students can find solutions and instructions on their own. However, the current scenario shows multiple obstacles. Concerning the wiki, (1) although it is available 24/7, the information acquisition is difficult due to (a) heterogeneous user group and their expertise, and (b) the content structure of the wiki, e.g., page tree structure, voluminous pages, which also leads to information overload. Also, (2) information acquisition is dependent on keywords or headings, which is problematic since users often do not know what to look for. (3) Due to the many contact channels, the students sometimes do not know which available channel to use for which questions. Further, (4) personal support is not available 24/7 and there is often a time delay between questions and answers due to resource constraints of the IT-service provider. Lastly, (5) personal contact is a perceived barrier since users are afraid to ask embarrassing questions personally.

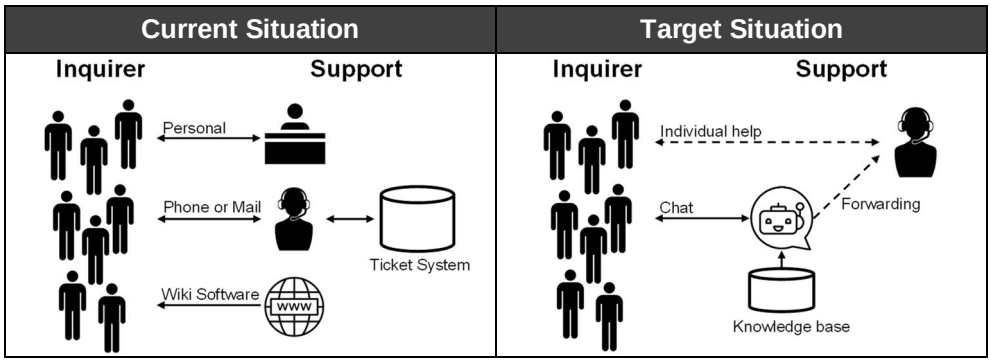


Figure 28 Case Scenario: (left) Current Situation; (right) Target Situation

To overcome the current obstacles in the IT-support of the university, the IT service provider plans to deploy a chatbot system for first-level support. The chatbot system should provide a centralized access point to solutions and instructions (see Figure 28, right). Thus, inquirers get personal answers in a natural way. Also, users do not have to use specific keywords or crawl through pages. However, if the chatbot is not capable of answering the question, it should forward the request to an IT-support employee for help.

5.4 Study Design

To evaluate the acceptance and the attitude of students, or rather the future users, towards an IT-support chatbot (RQ_5), we followed a three steps study process.

Firstly, based on the current situation in IT-support at the university, we developed a chatbot prototype. To this, we conducted a workshop with the responsible persons and decision-makers of the local IT-service provider to evaluate topics and instructions, which are demanded frequently. Furthermore, based on MEYER VON WOLFF ET AL. (2020b), we chose the three scenarios WLAN setup, contact search, and VPN setup.

Secondly, we evaluated the prototype and our three test scenarios.[20] We contacted students, as the future users of the IT-support chatbot, in our local library and online. The participants could test the prototype on-site, and on their own computers via a hyperlink to the system. During the participation, the students interacted with the chatbot on their own and performed three tasks according to our test scenarios: (1) *Use the chatbot to find out how to access the WLAN with a PC running MAC OS;* (2) *Get information about the university employee Mr. Bauer and find out his telephone number;* (3) *Use the chatbot to get help to install the VPN software to access the university's network.* To evaluate the students' experiences during performing these tasks, we used a questionnaire with both qualitative and quantitative questions consisting of three sections each (see Table 34). The participants were asked for their assessment of each individual task after they had gone through the respective task (A). After carrying out all three test scenarios, we used the standardized *User Experience Questionnaire* (UEQ) which measures the user experience based on attractiveness, efficiency, perspicuity, dependability, originality, and stimulation (B) (Laugwitz et al. 2008; Schrepp et al. 2017). Thus, the UEQ provides a simple and fast way to evaluate the user experience with less effort based on a questionnaire with 26 items grouped in six scales. Lastly, we added a section of general questions (C) to assess future use, and to identify improvement opportunities.

Section	Question	Type
A: Case questions (after each scenario)	I was able to complete the task with the chatbot.	Likert
	The chatbot interprets all my messages correctly.	Likert
	The used visualization elements of the chatbot were helpful in answering the questions.	Likert
	What did you notice positively or negatively when solving the task?	Text
B: User experience questionnaire (UEQ)	Please assess the product by ticking one circle per line (item): Attractiveness (6 items): *annoying / enjoyable, good / bad, unlikeable / pleasing, unpleasant / pleasant, attractive / unattractive, friendly / unfriendly* Perspicuity (4 items): *not understandable / understandable, easy to learn / difficult to learn, complicated / easy, clear / confusing* Efficiency (4 items): *fast / slow, inefficient / efficient, impractical / practical, organized / cluttered* Dependability (4 items)*: unpredictable / predictable, obstructive / supportive, secure / not secure, meets expectations / does not meet expectations* Stimulation (4 items)*: valuable / inferior, boring / exciting, not interesting / interesting, motivating / demotivating* Novelty (4 items)*: creative / dull, inventive / conventional, usual / leading-edge, conservative / innovative*	Likert (for each pair)
C: General questions	Would you use this chatbot if you had questions for IT-support in the future?	Likert
	Do you think information search with the chatbot is faster than by traditional means?	Likert
	Name three things that would improve the chatbot.	Text
	What did you find negative about the chatbot?	Text
	What did you find positive about the chatbot?	Text

Table 34 Questionnaire Structure of Study V

Thirdly, we analyzed the gathered data. For this, we used spreadsheet programs to process the case (A) and general questions (C). Extending this, we used structured content analysis to categorize the qualitative datasets for positive and negative experiences while using the chatbot (A, C) (Mayring 2014).

[20] See Appendix A5 for the applied scenarios and the questionnaire.

For the UEQ part of the survey (B), we used the UEQ Data Analysis Tool provided by the creators' official webpage.[21] The results of the evaluation are presented in the results section below.

5.5 Prototype Description

Based on the workshop with the local IT service provider, and the state-of-the-art chatbot architecture (Berg 2014; Mallios/Bourbakis 2016), we implemented a chatbot prototype (see Figure 29, left). First, we developed a graphical user interface (GUI) by using common web technologies (*HTML5*, *CSS3*, and *JavaScript*), which supports all kinds of devices with a responsive layout. Second, we developed the chatbot system in a *PHP* backend environment, which determines the logic and the procedure of the dialogs. For this, we used the *NLP.js* framework[22]. Based on the results of the NLP, the system determines the conversation path by updating the status, queries the required information, and displays them (see Figure 29, right).

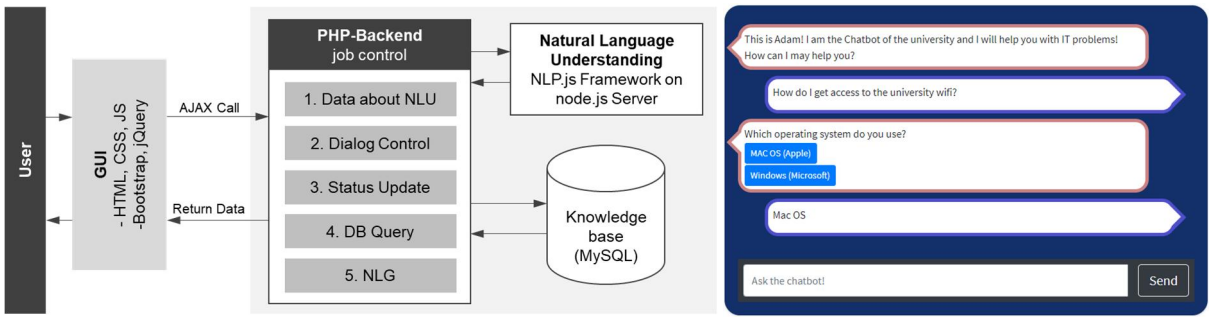


Figure 29 (left) Chatbot Architecture; (right) Chatbot User Interface

The **WLAN setup** scenario measures the feasibility of standard questions with only one input variable, and acceptance of plain text answers (see Figure 30, left). Therefore, the scenario consists of three different paths to get the instructions, which contain only text. If the user asks for WLAN setup without naming the operating system, the chatbot checks back which operating system is in use and offers the possibility to answer by buttons [1]. If the user types in only an operating system, the chatbot checks back whether the user wants to have information regarding WLAN setup or for something else [2]. If the user asks for the WLAN setup by stating the operating system, the chatbot gives the installation instruction [3]. The **contact search** scenario measures the feasibility of more complicated tasks with multiple input variables and a more variable conversation (see Figure 30, center). Also, it measures the acceptance of answers with small visual support. Therefore, the scenario consists of four paths to find a person and the answer contains icons. If the user asks for a contact search without giving contact information or writing contact information without a question, the chatbot system checks back for further contact information or for the tasks it should perform with the given information [5,6]. If contact information and the question for a contact search are provided, the chatbot system searches through the database with the given information. If multiple persons are found, the system tells the user the number of found persons and the options to deliver more information to find the unique person or to ask

[21] User Experience Questionnaire is available at https://www.ueq-online.org/.

[22] NLP.js is a general natural language library for node.js: https://github.com/axa-group/nlp.js.

the chatbot to display all found persons [7]. If a single person is found [8] or after a check back [6], the contact information is shown. The **VPN setup** scenario measures the feasibility of simple standard questions without input variables, but with a step-by-step instruction answer (see Figure 30, right). Furthermore, it measures the acceptance of answers with full graphical support. Therefore, the scenario consists of two different paths to get setup instructions, and the instructions are supported by screenshots of the setup process. If the user asks for a definition of the term *VPN*, the chatbot system gives the definition and checks back whether the user would like to additionally get a setup instruction [10]. The user can also directly ask for setup instructions [11]. Subsequently, the chatbot system asks if the user wants further help and provides further instructions [12]. Regardless of the scenario, the system checks back if its answer was useful along with a placeholder for further information and links [4,9,13]. Also, buttons were implemented in certain places to offer the user a selection choice instead of having to type the selection.

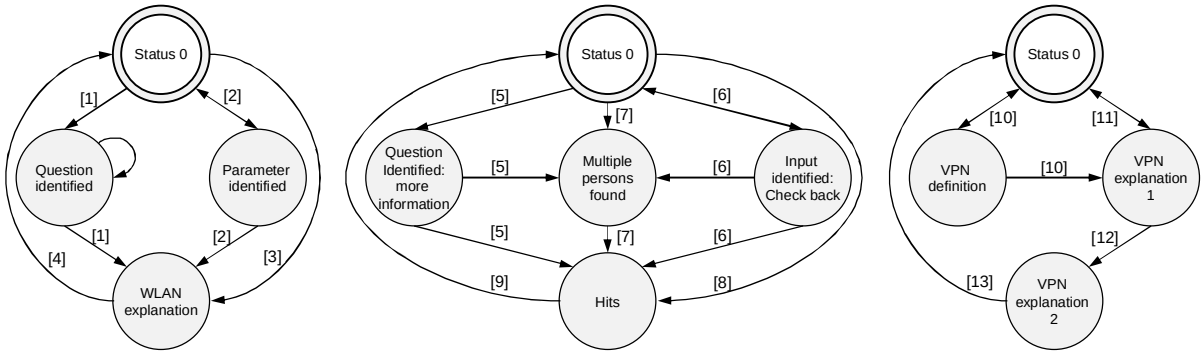


Figure 30 Scenario Structure: (left) WLAN Setup, (center) Person Search, (right) VPN Setup

5.6 Results

We could acquire 93 students to participate in our study. Mostly, male students participated (approx. 62 %) followed by approx. 31 % of female students. Additionally, approx. 43 % of our participants use a chatbot on an occasional basis (*n*=41) followed by 27 students who have not used a chatbot before. Also, some participants use chatbot systems regularly (*n*=9; approx. 10 %). Overall, more than half of the participants have already had prior chatbot experiences (*n*=66; approx. 71 %).

5.6.1 Test Scenario Evaluation

In the first step, we evaluated our test scenarios and the respective design decisions based on the questionnaire utilizing a 7-point Likert scale from 1: disagree to 7: agree (see Figure 31).

Overall based on the average values over all three scenario questions, the VPN setting was rated best (6,14) followed by the search setting (5,61) and the WLAN setting (5,54). Across all test cases, the solvability was rated best in each case with an average value above 6,00. However, especially for the VPN task, the solvability was by far the best (6,44). Additionally, also the speech understanding of the chatbot was rated high. Again in the VPN setting the rating was highest (6,00) followed by the search (5,47) and WLAN (5,80) setting. In terms of visualization, we raised a slightly different distribution. Again, especially the VPN setting has the highest rating with an average of 5,99. However,

for search, we only have an average of 5,30 and for the WLAN setting only of 4,80. Therefore, particularly for the solvability, our first pilot prototype shows a fit for IT-support tasks. Nevertheless, for language understanding and visualization adjustments are necessary. Especially, the language understanding must be enhanced in the search task. A possible reason for the lower rating, in this case, could be the more open approach of person search, e.g., different request phrases, as opposed to the more structured processes in VPN and WLAN setups, where after a starting question a process is followed. Additionally, the visualization in the search and WLAN task must be enhanced. A possible reason could be the lower amount of visualization in the WLAN dialogs in contrast to the VPN task. However, especially during the VPN setup, the provided visualization options were received positively. Therefore, a similar approach should also be applied in the first two tasks.

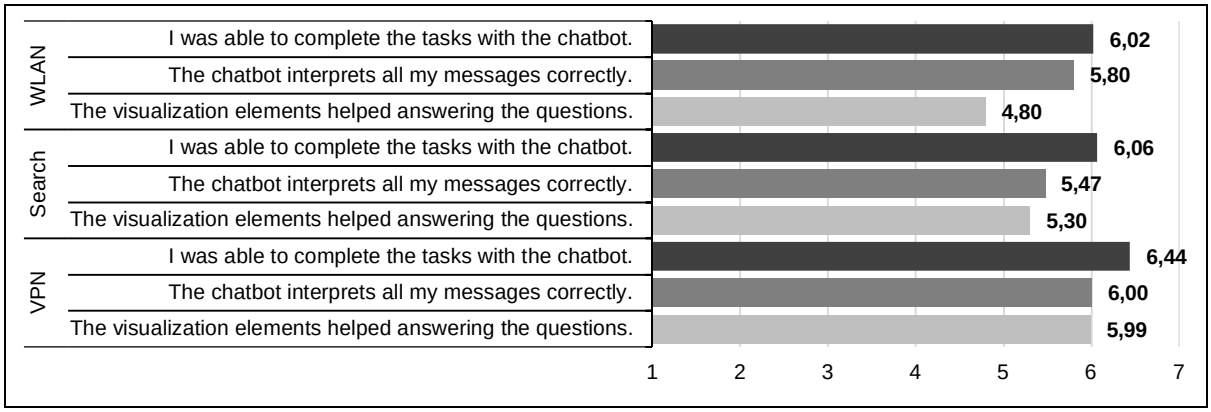


Figure 31 Evaluation of the Test Scenarios

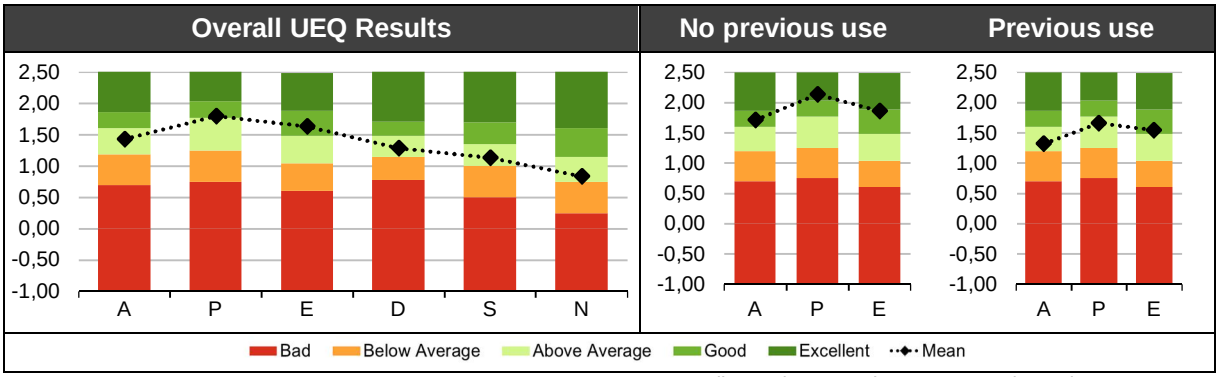
Additionally, we evaluated the chatbot based on two general questions (7-point Likert scale: 1: disagree; 7: agree). The participants would tend to use the chatbot in future settings when they need IT-support (*mean*=5,67). Therefore, we argue that they are largely satisfied with the experiences made. Furthermore, in terms of timeliness, our participants rate the chatbot as faster as the traditional means (*mean*=5,78).

5.6.2 User Experience Questionnaire Evaluation

Furthermore, we comprehensively evaluated the user experience in terms of attractiveness, pragmatic quality (perspicuity, efficiency, and dependability), and hedonic quality (stimulation and novelty) based on the UEQ with a 7-point Likert scale (Laugwitz et al. 2008; Schrepp et al. 2017). For this, we analyzed the data set with the official analysis tool and removed suspicious data sets suggested by the tool, e.g., random or not serious answers, identified by the difference between the best and worst evaluation of an item. We excluded five suspicious data sets, resulting in 88 data sets for the analysis and the calculation of the UEQ.

As shown, our pilot prototype notably achieved high values in *perspicuity* (P) and *efficiency* (E) (1,80 and 1,63) (see Figure 32; left; axis dimensions reduced from -3/+3 to -1/+2,5). Thus, our prototype is perceived as, easy to learn and to understand, as well as fast and efficient in solving the tasks without unnecessary effort. Therefore, the results confirm the basic idea behind a chatbot application. Instead of users having to search for solutions and instructions themselves, and experiencing problems like information overload due to the many available systems and sources, a chatbot provides a single answer

or can narrow down all possible answers through a natural language dialog. Additionally, the high value for efficiency can also be confirmed by the previous evaluation, if a chatbot is faster compared to traditional means. Additionally, the overall impression in terms of *attractiveness* (A) was rated quite high (1,44). Subsequently, our participants could anticipate the behavior of the system and felt they had control over the system (*dependability* (D): 1,29). Also, the participants found the interaction with the prototype enjoyable and motivating (*stimulation* (S): 1,13). Nevertheless, the *novelty* (N) aspects of our chatbot system are rated slightly lower (0,84), which is quite surprising since chatbots are still a novel system. However, as seen in the sample description, many of the participants have already gained experience with chatbots in the past and the content provided is not new. Also, chatbots should provide a natural and intuitive way to information. Thus, maybe it is even better not to offer something new but something familiar, which is reflected by the lower *novelty* rating. Nevertheless, the *novelty* rating is still assessed as positive.



***Note**: Overall n=88 | No Previous Use n=26 | Previous Use n=62*

Figure 32 UEQ Evaluations of the Chatbot (created with the official UEQ Benchmark Tool)

Overall, we could achieve quite good results for a chatbot-based IT-support. Based on the official UEQ benchmark (Schrepp et al. 2017), which compares our results with a data set of 452 UEQ-studies of different products, e.g., business software, web shops, or social networks, our chatbot is always above average in every single score. In terms of *attractiveness*, *dependability*, *stimulation*, and *novelty* only 25 % of the data set are better and 50 % worse. The *attractiveness* is rather good than below the average. Especially for *perspicuity* and *efficiency*, our first pilot is rated good compared to the reference products of the data sets, with even only 10 % of the results being better and 75 % of the results being worse. Therefore, our evaluated chatbot performs relatively well compared to other products, which are evaluated with the UEQ as well.

Additionally, we compared the UEQ results of the users with no previous chatbot experience (*n*=26) and those who have previously used chatbots at least once (*n*=62) (see Figure 32, right). The results for *dependability*, *stimulation*, and *novelty* were quite the same and differ only in a lower mean value for the group with previous use. Nevertheless, in both groups, the results for *dependability*, *stimulation*, and *novelty* are still rated above average in the benchmark. However, we found major differences in *attractiveness* and the two dimensions: *perspicuity* and *efficiency*. Especially for those participants for whom the interaction is new, the *perspicuity* was rated as excellent (2,13), compared to the other group (above average; 1,66). The same distribution is present for *efficiency*. Participants with no previous use rate our chatbot as excellent (1,86) compared to students with previous experience (good; 1,54). Also,

for *attractiveness*, the first group rated the chatbot as good compared to above average in the second group. In a two-sample t-test the differences of *attractiveness* and *perspicuity* could be verified significantly based on α-level of 0,05 (*attractiveness*: *p-value*=0,0477; *perspicuity*: *p-value*=0,0292). Overall, users with no experience rated the chatbot rather good to excellent, whereas users with experience rated the chatbot rather above average. Therefore, especially users with no previous experience are impressed by our solution.

5.6.3 Qualitative Assessment

Finally, we assessed the chatbot based on six open questions (one after each test scenario and three overall at the end). We received 229 statements that could be grouped into 11 positive, 9 negative, and 8 enhancement categories. In the following, we outline only the most relevant notes, which were given by at least 10 % of our 93 participants (see Table 35).

Positive	***n***	**WLAN**	**Search**	**VPN**	**Overall**
Fast responses	41	~	~	–	~
Providing appropriate/good answers	22	~	~	~	~
Visualization (e.g., pictures, buttons, links)	16	~	–	~	~
… and 8 further aspects	≤8				
Negative	***n***	**WLAN**	**Search**	**VPN**	**Overall**
Understanding problems	19	~	~	~	~
Visualization (e.g., answers, pictures)	10	~	–	~	~
… and 7 further aspects	≤6				
Enhancement	***n***	**WLAN**	**Search**	**VPN**	**Overall**
Design	16	–	–	–	~
Improve the language understanding	15	~	~	~	~
Improving the responses (e.g., structure, length)	13	~	–	~	~
… and 5 further aspects	≤4				

Table 35 Qualitative Assessment Categories

The participants emphasized the answer speed and the quick solution finding especially **positive** (*n*=41). In doing so, the chatbot can provide the solutions based on only a few statements, which works faster than writing e-mails and waiting for responses from the IT-support. Furthermore, many participants stated that the chatbot was capable of providing appropriate answers (*n*=22). The chatbot provides both, correct solutions and suitable answers as well as clear and understandable responses. In addition, the provision of further potentially relevant information or the forwarding to consequent dialog steps was positively received. Also, the provided visualizations were received well (*n*=16). The links to further resources, the buttons for a faster selection in the dialogs, and the use of pictures in the introductions were mentioned among others. Besides this, things like speech understanding (*n*=7), dialog feeling (*n*=8), simplicity (*n*=6), or selection options in the dialog (*n*=5) were mentioned.

As **negative** aspects, our participants mostly noted understanding problems (*n*=19). The participants mentioned that the chatbot sometimes does not understand the utterances or misinterprets them, e.g., solutions for the wrong operating system were given. Nonetheless, this is a typical chatbot problem,

which must be addressed from beginning on by continuous training. However, although also noted positively, the visualization, and specifically the design, was negatively perceived by some participants (*n*=10). Especially, some pictures were blurred and the overall design does not meet all expectations of modern systems. Further aspects include keeping the context (*n*=6), lengthy responses (*n*=5), or strange requests (*n*=4), etc.

Lastly, we surveyed **enhancement** suggestions. Mostly, the participants propose to update the design (*n*=16), e.g., modern and simpler, icon design as well as more buttons for the dialog control. As already noted, as negative, the language understanding should be improved (*n*=15) so that messages can be better understood and the right information can be provided. Additionally, we should increase the level of humanity, e.g., kindliness, funny, small talk. Furthermore, the responses should be revised (*n*=13). These include more precisely answers, the structuring of the answers, e.g., step-by-step enumerations instead of continuous text, word highlighting, hyperlinks, or generally shorter replies. Further suggestions encompass more functionalities and an increased knowledge base (*n*=4) as well as spelling and punctuation (*n*=3).

5.7 Discussion and Conclusion

Based on our pilot case study for university IT-support chatbots, we could analyze the students' attitude towards chatbots in our case and their assessment of three test scenarios. Our findings show that a chatbot is capable of solving each of our three test scenarios. Therefore, all three scenarios are possible application areas. Thus, we could verify the requirements of MEYER VON WOLFF ET AL. (2020b) for these three cases. Based on the UEQ analysis we show quite good results for the pilot chatbot, whereas the perspicuity and efficiency are rated as good, which is underlined by the evaluation of solvability in the test scenarios. This is also reflected since the students rate the chatbot-based problem solving faster as compared to traditional means. Only the novelty aspects turn out worse. However, we argue that this is quite good since we want to provide an intuitive way for information. Typically, systems that are perceived as novel are associated with an increased learning effort. Also, we could show that visualization is preferable in chatbot answers, as the test scenario with the most visualization options, the VPN setup, was rated as the best compared to the one with nearly no visualization, the WLAN setup. Most of the results are also reflected in the qualitative assessment as mostly the response speed, the answers, and the visualization were mentioned positively. Additionally, understanding problems are mentioned again that must be addressed in the following. However, this is a typical chatbot problem, as they must be retrained continuously from the beginning, to increase the language understanding, and to provide increasingly better solutions. Additionally, repair mechanisms could be helpful when interpretation errors occur (Følstad/Taylor 2020). Also, the overall design should be overhauled for a real application along with a larger knowledge base, so the chatbot can answer more questions than our three test scenarios. If a sufficient knowledge base cannot be provided, this might lead to students rejecting chatbot-based support. Also, consideration should be given to including support for small talk, since this can further enhance the adoption of chatbots in educational settings, or further in the support department (Hobert/Berens 2020). This was also already found by LIEBRECHT/VAN HOOIJDONK (2020),

who try to enhance the natural and personal feeling of a chatbot. Nevertheless, our results and evaluations already show a basic acceptance of chatbots in IT-support tasks. Furthermore, our UEQ results, and the positive outcome especially for the users with no chatbot experience, highlight that we can particularly convince them to use a chatbot instead of classic support channels. However, this may be due to the novelty effect of chatbots since users who have used them at least once judge them more critically. Also, the latter maybe already used more powerful chatbots, which supports the thesis that our chatbot should be further improved. Therefore, based on our study results, we could deduce four design recommendations for (IT-)support chatbots. In a recent study by GNEWUCH ET AL. (2017), similar results for the general customer service are found, which, therefore, support our findings for the educational setting, and vice versa. (1) Chatbots should encompass a sufficiently large initial knowledge base, where multiple answers and instructions for a given use case or scenario are handled. (2) The knowledge base content should be content-wise prepared. This means that both, visualization elements, e.g., pictures or videos must be stored, as well as the contents must be stored with structuring, e.g., enumerations, highlighting, and so on. (3) The design of a chatbot should be modern and comparable to known messenger systems. (4) For chatbot dialogs, it is necessary to not only go through dialogue steps or instructions, while at the same time answering emerging questions. Especially for the heterogeneous user groups, it cannot be assumed that every user knows all (IT-related) terms. Therefore, emerging questions should be answered in the dialog regardless of whether instructions are described or just information is requested. However, with increasing task complexity, the volume of preparation of content and dialog structure is growing. Hence, the effort increases, depending on the degree of complexity. Thus, we contribute to the scientific knowledge base by confirming that the IT-support is a useful chatbot application, especially in higher education. Additionally, we verify previously surveyed requirements for the design of such an information system.

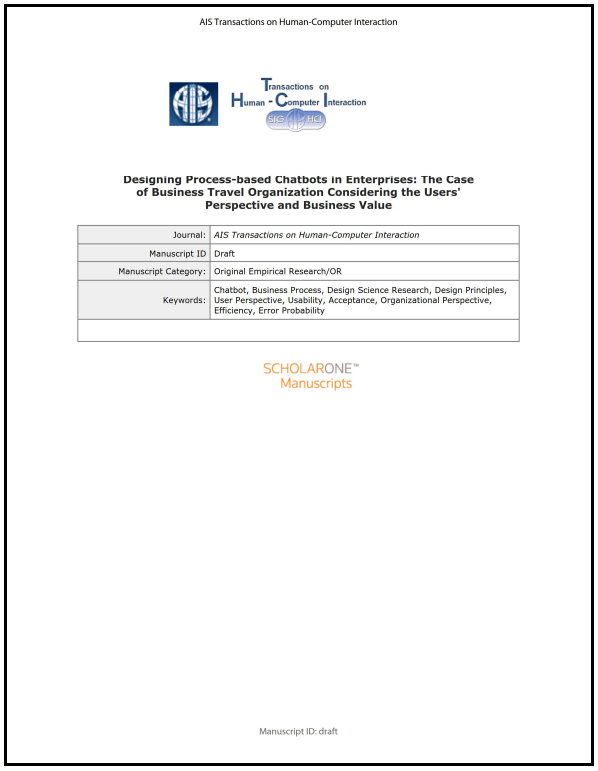
As with every research study, some limitations exist that need to be pointed out. Firstly, the findings are mainly dependent on the students' responses and their willingness to participate. Therefore, we have tried to maximize the reach in order to acquire as many participants as possible. However, the group of economic students is overrepresented, which could bias our results. Secondly, we surveyed only the case of a service provider of a German university, which makes the generalizability of the results difficult. Thus, the results are not necessarily transferable to all countries and their cultural and legal circumstances, e.g., data protection and security in Europe compared to the rest of the world. Additionally, some countries are already in advanced stages of chatbot deployment, leading to new or more advanced basic requirements of users. However, since we examine the general case of a service provider, which is existent in all countries or business areas, we are assuming that our results are relevant for many other service providers, and, thus, are generalizable and transferable. Nonetheless, in advance of every single chatbot project, existing countries' conditions should be individually assessed in order to take them into account. Additionally, in future research, a – at best worldwide – field study based on our approach should be conducted to increase the number of participants and include more individual specifications. Therefore, the origin of the participants as well as the surveyed countries should be further extended. Thirdly, we developed only a prototype for the given scenario. Therefore, the chatbot functionality is strongly limited. As shown some negative aspects and enhancement opinions

exist. However, the positive feedback and UEQ results already point out the fit and usability of the chatbot for the IT-support task.

Even though our study may have some limitations, our results seem to be valuable and useful for chatbot applications in the area of university IT-support. Of course, the results can also be transferred back to the business context, as there are similar problems and requirements that need to be addressed, especially in first-level customer support, which is the equivalent to our case. Overall, our findings underline the potential of chatbots for IT-support tasks, as the solvability in all of our test scenarios was given, and the attitude of users was positive. However, as we measured the assessment in terms of user experience with the UEQ framework, it may be necessary to conduct further, more in-depth, and extensive user studies, with subsequent requirement surveys.

6 Process-based Chatbots for Business Processes

> Designing Process-based Chatbots in Enterprises: The Case of Business Travel Organization Considering the Users' Perspective and Business Value



AIS Transactions on Human-Computer Interaction

Transactions on Human-Computer Interaction

Designing Process-based Chatbots in Enterprises: The Case of Business Travel Organization Considering the Users' Perspective and Business Value

Journal:	*AIS Transactions on Human-Computer Interaction*
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Keywords:	Chatbot, Business Process, Design Science Research, Design Principles, User Perspective, Usability, Acceptance, Organizational Perspective, Efficiency, Error Probability

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Manuscript ID: draft

Abstract Chatbot research receives a lot of attention in the last years and the technology is increasingly being used in everyday working life. Employees should use the systems intuitively without further training by natural language, and the chatbot adapts itself to the respective user. Especially, for customer support or information acquisition, chatbots are applied successfully. For this, a lot of research has been done on user experience, humanness, and design in the last few years. However, the application of chatbots for business processes as they occur regularly in employees' working days received less to no attention so far, resulting in missing design recommendations and unachievable benefits. Notably, the economic and user-related effects are also barely considered, and remain unknown.

To address this, we conducted a design science research study to survey a process-based chatbot application for business processes. We examine this application scenario and deduce design principles for process-based chatbots, and implement a software artifact based on the design principles. In order to determine the benefits and impacts, we conducted an experiment with 69 participants of three distinct groups, and, besides comparing the process-based chatbot with a current business process, survey the users'

perspective in terms of design and acceptance, and the organizational perspective in terms of process efficiency and quality. The participants used the chatbot for two scenarios and filled out a questionnaire, and an interview was also conducted with the experts' group.
In doing so, (1) we could derive six design principles for process-based chatbots according to the users, the process, and the scientific literature, and implement a respective chatbot. The chatbot enables the business process, adapts itself to the user, provides situational-dependent input options, and supports in the dialog. (2) We provide positive insights on the users' attitude towards using chatbots for business processes. Notably, a high user experience and acceptance were measured, and usage can be assumed. (3) Economically, the process efficiency was comparable with existing solutions, whereby IT-affinity or experience had no influence. Furthermore, the process quality was improved compared to the previous solution. (4) The achieved results were transferred into a nascent design theory to provide generalized results.
Thus, our results prove the applicability of chatbots in workplace settings for business processes. With the study, we contribute by providing design knowledge on process-based chatbots and showing the possible impacts on the users and the company.

Keywords Chatbot, Business Process, Design Science Research, Design Principles, User Perspective, Usability, Acceptance, Organizational Perspective, Efficiency, Error Probability

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6.1 Introduction[23]

Nowadays, companies increasingly rely on the application of natural language user interfaces in general and chatbots in specific. Likewise, the current scientific community more frequently publishes contributions on related topics, (e.g., Diederich et al. 2022; Lewandowski et al. 2021). Mainly to support and relieve employees in daily work scenarios, chatbots are often used in (customer) support areas or as a means of information acquisition and provision (Følstad/Brandtzæg 2017; Maedche et al. 2019). Notably, the chatbot trend is bolstered by current digitalization efforts to support users, automate tasks, and relieve employees, thus enhancing work practices and quality. Consequently, many established work practices have vanished or changed, and innovative and digital technologies are more commonly used in daily work. Moreover, such changes affect almost every employee in all areas of a company (Byström et al. 2017; Köffer 2015; White 2012). Therefore, recent studies have suggested that user-centric information systems like chatbots should be provided to employees to support them individually. In addition, by using chatbots, the digitalization problems of information and application overload should be tackled further. It has been shown that chatbots are a promising information system because users can control them or other (enterprise) systems without prior training due to their natural and human-like capabilities. Instead of learning extensive and complex user interfaces, users should ideally just write or speak their needs and the chatbot executes the corresponding business functions or provides the desired information (Aquino 2012; Carayannopoulos 2018; Følstad/Brandtzæg 2017). Also, prior research has shown that chatbots are a suitable technology to provide user-centered design. Chatbots should individually adapt themselves to the users' needs and assist them in their daily work by clarifying questions and filtering information (Carayannopoulos 2018; Følstad/Brandtzæg 2017; Richter et al. 2018). Process automation is provided by chatbots answering questions on their own, especially in customer support scenarios, resulting in work relief and improvements of the working quality (Gnewuch et al. 2017; Meyer von Wolff et al. 2020a). Notably, the human-like and natural design should also contribute to a positive user perception and service experience, and create a feeling of personal contact although actually interacting with an application system (Diederich et al. 2019a). Particularly in customer-oriented areas, such as customer service, sales, and financial advisory, chatbots have already demonstrated that they can produce positive effects (Gnewuch et al. 2017).

While chatbots often target customers or external users, employees also carry out time-consuming activities, processes, or business transactions in their daily work lives, e.g., changing personnel data, planning of meetings, and organizing business travels. Research has already investigated several business applications of chatbots, both in terms of general information provision and specific functions such as customer support (e.g., Bavaresco et al. 2020; Diederich et al. 2022; Feng/Buxmann 2020; Lewandowski et al. 2021). Besides individual approaches to design aspects, little research, however, has focused on the use of chatbots for process support or process execution with chatbots in everyday office life. Especially, the studies on work task execution have focused mainly on simple tasks (e.g., resetting a password), and less on intelligent workflows or whole processes (Feine et al. 2020a).

[23] Section 3B6 contains the content of the initial version as submitted accordingly to the call for paper.

Concerning this, studies exist that deduce design principles for business chatbots (e.g., Feine et al. 2020a; Meyer von Wolff et al. 2021a), or a taxonomy (Janssen et al. 2020), as well as some studies that survey potential effects and adoption criteria of chatbot applications (e.g., Meyer von Wolff et al. 2020a; Rodríguez Cardona et al. 2019; Winkler et al. 2019). Furthermore, a lot of research was conducted on social cues and anthropomorphic features and the resulting design aspects (e.g., Diederich et al. 2020; Liebrecht/van Hooijdonk 2020). Notably, the common knowledge among current research on chatbot applications is that users are more satisfied with chatbots that have anthropomorphic and human characteristics. However, to support employees in their daily lives and to be used by them, chatbots must be integrated into their workflows and must be able to handle the work task. The decisive factor thereby is the business value to be achieved. Otherwise, chatbots will not even be considered by companies as possible information systems. Current research has shown that chatbots can, in principle, carry out processes and transactions (e.g., Chakrabarti/Luger 2015; Meyer von Wolff et al. 2020d; Winkler et al. 2019). However, to the best of our knowledge, no study has explored this with a real-case application or in comparison with current enterprise solutions.

Hence, while the literature offers preliminary design contributions and presumes that chatbots have a potential for business processes, it also contains a research gap: The application of chatbots for business processes in working environments and the outcomes of this application. This is problematic for three reasons. First, the current potentials for (simple) tasks and functions could not be transferred to process applications as they occur in the workplace nowadays. Second, the current chatbot research does not reflect actual daily working situations, and the results are not related to or compared with a current situation, e.g., comparison of cycle times or successful completion of tasks. Hence, the integration of chatbots in the workplace and the utilization of previously achieved findings are further hindered, as companies can only assume what their impact will be. Third, the success of chatbot projects largely depends on the users. Since users only work with the natural language user interface, this must, without exception, also be suitable for process applications. Otherwise, chatbots will not be used.

As chatbots have the potential to provide employees with individualized and intuitive access to resources and business processes while offering unique assistance, we conducted a *Design Science Research* study (Hevner et al. 2004; Hevner 2007). We surveyed the business process application based on the exemplary process of business travel organization in terms of business travel requests and business travel accounting. Therefore, first, the design aim of the study was (1) to survey the requirements for process-based chatbots and (2) to design a process-based chatbot based on these requirements for the exemplary business travel organization process. Thus, we address the following research question:

RQ_61	How should enterprise process-based chatbots for business processes be designed?

Second, as the design is just the first step and, especially for real case applications, users must be willing to use the system and a business value must be created, we also evaluate the effects and outcomes. We examine the issue from (1) the individual perspective as well as (2) on the organizational level. To address both perspectives, we conducted an experiment and compared our process-based chatbot artifact with the actual business travel organization process implemented in a productive environment. Since usage is a key factor in determining success that depends on the users, we

necessarily considered the user's perspectives beforehand. As employees as the future users only come into contact with the natural language user interface, it is necessary to examine the user experience and their satisfaction, but especially also in comparison to current business solutions. In addition, we examined users' acceptance to avoid the risk of misinvestment and lack of utilization. Therefore, we address the following user-focused research question:

$RQ_6 2$	How do users assess the application of process-based chatbots for business processes?

Furthermore, we concluded that even if the users' preconditions are met, it is also necessary to apply an organizational perspective to determine the business value of a chatbot application in digital workplaces. Consequently, we examined whether chatbots can execute business processes and the extent to which they are comparable to current solutions, especially in terms of process lead times and error susceptibility. In doing so, we investigated whether chatbots can be successfully used for business processes, and what effects can be achieved. Therefore, we address the following organization-focused research question:

$RQ_6 3$	What is the business value of process-based chatbots for business processes from an organizational perspective?

This paper is structured as follows. In the next section, we highlight the theoretical foundations of chatbots in business contexts and the current evaluation of chatbots. Next, we describe our applied *Design Science Research* approach. Afterward, we present our process-based chatbot artifact and its corresponding requirements and design principles. Following this, we show the results of the evaluation based on user and organizational perspectives. Next, we discuss our results and summarize the findings in the form of a design theory. The contribution ends with an overview of its limitations and a short conclusion

6.2 Related Research

6.2.1 Defining the Terminologies

As chatbot research has recently attracted considerable attention (Feng/Buxmann 2020; Lewandowski et al. 2021), various definitions of the term have emerged in the literature, some of which differ from each other and yet are similar. Thus, it is necessary to define the term for a unified understanding of the topic for this paper. Chatbots, also known as smart personal assistants (Winkler et al. 2019; Winkler et al. 2020b), conversational agents (Diederich et al. 2022; Elshan/Ebel 2020; Feng/Buxmann 2020; Gnewuch et al. 2017; Lewandowski et al. 2021), and summarized as digital assistants (Maedche et al. 2019) or conversational user interfaces (Holmes et al. 2019), are information systems that use artificial intelligence and machine learning in the context of natural language processing to provide a dialog-based user interface. Users can communicate naturally with these systems to gather or store information and execute business processes or work tasks. From a technical point of view, chatbots process the input to extract patterns and identify users' intent. Based on their intent, chatbots provide information, answer questions, or execute functions and processes. Therefore, besides the chatbots'

knowledge base, chatbots must be integrated with databases and (enterprise) systems (Meyer von Wolff et al. 2021a).

As mentioned in the introduction, nowadays, some researchers seek to transfer the promising results regarding chatbots to the application area of the digital workplace to support or execute business processes (e.g., Elshan/Ebel 2020; Feine et al. 2020a; Hobert/Meyer von Wolff 2019). These digital workplaces are generally not limited to physical places. Rather, the concept describes the coincidence of work tasks, business processes, enterprise systems or databases, technologies, as well as employees, and customers (Dery et al. 2017; White 2012).

6.2.2 On Chatbots in Business Contexts

For the application of chatbots in business contexts, the current chatbot research mostly focuses on customer-focused topics such as customer support or service (e.g., Corea et al. 2020; Gnewuch et al. 2017; Johannsen et al. 2018; Liebrecht/van Hooijdonk 2020; Zierau et al. 2020). Also, information acquisition or provision with chatbots are topics of interest in the scientific community (e.g., Al-Zubaide/Issa 2011; Carayannopoulos 2018; Chai et al. 2001; Radlinski/Craswell 2017; Ranoliya et al. 2017). Notably, one study highlighted professional workplace-related information acquisition, e.g., from ERP and CRM systems (Reshmi/Balakrishnan 2016). Furthermore, actual workplace applications for employees are examined. LECHLER ET AL. (2019) showed how chatbots may support feedback exchange. Other studies also examined chatbots as teammates (Elshan/Ebel 2020), as a tool for problem-solving tasks (Winkler et al. 2019), or for reducing friction in collaborative teamwork (Gyton/Jeffsry 2017). Besides this, some researchers attempted to enhance chatbots with more intelligence to better support processes and not only respond to questions. For example, TAVANAPOUR ET AL. (2019) followed a process-like approach in which the chatbot supported the idea generation process by asking questions and acting like a facilitator. A different study used a goal fulfillment map like a finite-state machine to map the dialog and to allow for longer and more dynamic interactions in customer support settings (Chakrabarti/Luger 2015). A similar study implemented a finite-state machine chatbot to provide support for complex tasks such as e-learning and education (Hobert 2019b). In this study, the current dialog state was continuously adjusted based on the users' intent, and the corresponding actions were triggered. Likewise, another study applied an approach that dynamically adapted the dialog based on the current interaction(Winkler et al. 2020a). Although the last two studies focused on e-learning and teaching, they demonstrated the ability of chatbots to map processes as they could occur at the workplace as well.

Apart from the research on individual application areas, many studies have analyzed chatbots' features or design aspects on a more general level. Significantly, one research domain thereby addresses the humanization of chatbots and their response behavior (e.g., Diederich et al. 2020). One such study examined human response behavior as a requirement for more human-like chatbots by deriving possible linguistic elements and investigating their contributions (Liebrecht/van Hooijdonk 2020). The results show a high impact of anthropomorphic design features on perceived usefulness. Another study surveyed the impact of implemented anthropomorphic and functional features on the acceptance of chatbots (Rietz et al. 2019). In contrast to the previous two studies, the results indicate that for a

workplace application in particular the usefulness and not the humaneness is important. In SCHUETZLER ET AL. (2018) the influence of conversational relevance on the perception of humanity and engagement is surveyed. The results show that chatbots, which provide relevant responses, are perceived as more human-like and socially. Lastly, ADAM/KLUMPE (2019) outlined the influence of human features like message interactivity or self-disclosure.

In addition, the general design and usage of chatbots is a field of research. For example, STOECKLI ET AL. (2018) showed functional affordances and the possible contribution of chatbot usage. FØLSTAD/SKJUVE (2019) focused on the chatbots' user experience, and the users' motivation to use a chatbot. Lastly, WUENDERLICH/PALUCH (2017) examined the user perception of chatbots. Furthermore, most of the design science-oriented contributions outline generalized design principles. To list just a few, GNEWUCH ET AL. (2017) presented generalized design principles for designing chatbots for customer service, and TAVANAPOUR ET AL. (2019) derived design principles for a chatbot to support the idea generation. Notably, DIEDERICH ET AL. (2020) provided design results on anthropomorphic chatbots for enterprises, and FEINE ET AL. (2020a) outlined design recommendations for enterprise chatbots in general.

Besides this, the current research also provides comprehensive overviews for the application of chatbots in business contexts. Notably, some studies pointed out generalized use cases for chatbots in business contexts (e.g., Feng/Buxmann 2020; Laumer et al. 2019b; Meyer von Wolff et al. 2020a; Stoeckli et al. 2018). They outlined the viability of chatbots for information provision and business processes like self-service tasks, which is the point of research in this contribution. Lastly, summarized results in terms of literature reviews (Feng/Buxmann 2020; Lewandowski et al. 2021; Meyer von Wolff et al. 2019a), or taxonomies (Janssen et al. 2020) exist for chatbots in business contexts as well.

Overall, the current research on chatbots mostly examines the answering of user questions and information provision. Few studies have attempted to extend this capability by adjusting the dialog or implementing some kind of low-level processes as they occur at the workplace. Consequently, to the best of our knowledge, the application of chatbots for processes in general and business processes in specific has not been sufficiently explored in the literature. The suspected potential of chatbots for business processes, e.g., user-centric information systems, intuitive use, individual support, has, therefore, not yet been inspected and determined in the business context for processes. Notably, this is critical as in companies often several users are involved, company-specific conditions must be considered, and data protection must be ensured. Thus, a simple transfer of the previous general or application-independent research results is not possible. However, a large scientific knowledge base exists for the design of general chatbots and specific chatbot features, some of which apply to enterprise process applications as well. Therefore, we built upon this knowledge base when deriving design principles for our process-based enterprise chatbot.

6.2.3 On the Evaluation of Chatbots

Besides the design-oriented contributions, the scientific literature already contains first surveys and evaluations to measure the influences and outcomes of chatbots. Of course, many of the existing *Design*

Science Research studies evaluate the design principles or requirements of their respective chatbots to identify their improvement potentials or generalize their findings (e.g., Feine et al. 2020a; Gnewuch et al. 2017; Hobert 2019b; Tavanapour et al. 2019; Winkler et al. 2020a). Also, CARAYANNOPOULOS (2018) evaluate how the design elements and capabilities of chatbots reduce the complexity of new situations and assist users by quickly providing them with the necessary information. Furthermore, a design study investigated the difference between a human and a chatbot based on a 'wizard of oz'-study and reported that the chatbot was on the same level as the human in interaction and task facilitation (Bittner et al. 2019). In addition, two studies examined the influences of chatbot applications and reported positive results (Winkler et al. 2019; Winkler et al. 2020a). One analyzed the influence of chatbot usage on group performance in problem-solving scenarios (Winkler et al. 2019), whereas the other surveyed the influence of scaffolding and voice-based chatbots on learning performance in the sense of information retention and transferability (Winkler et al. 2020a). In both contributions, the capability to conduct the given scenario was confirmed.

Besides these rather design evaluations, also dialog designs and decisions are evaluated. CHAKRABARTI/LUGER (2015) survey how good chatbots conduct conversations and how successful they are. They show that their finite-state machine-based chatbot is capable of maintaining a conversation context. In doing so, the chatbot went beyond simple utterance exchanges, and the resulting artificial dialogs were virtually indistinguishable from a natural one. Other studies analyzed the influence of typing delays on user perception (Gnewuch et al. 2018), and the influence of chatbots' conversational relevance on the perception of humanity and engagement (Schuetzler et al. 2018). The first study showed that dynamic typing delays positively affected users' perceptions and was perceived as more human. Thus, the users seemingly had the same expectation for the chatbot as they have for human-human interactions. The latter study concluded that conversational agents that give conversationally relevant responses are perceived as more human-like and social.

In the literature, humanness can be treated as a separate research area. DIEDERICH ET AL. (2019a) surveyed the empathetic behavior of chatbots and their influence on customer service. They show that when the chatbot can detect the users' sentiment to provide empathic responses, the chatbot is better perceived and the overall satisfaction is higher, even if the task could not be fully completed. Another study explored the influence of different features, e.g., high vs. low message interactivity and platform self-disclosure, in the case of onboarding (Adam/Klumpe 2019). A recent study investigated the relationship between persuasive and anthropomorphic conversational agent design and performance (Lichtenberg et al. 2021). They show that just adding more anthropomorphic features did not necessarily improve perception. MANSEAU (2020) surveyed possible outcomes of chatbot applications in the workplace and stressed the importance of anthropomorphism in increasing the acceptance of chatbots. Likewise, another study targeted the influences of anthropomorphic elements and usability on system acceptance and reported that a stronger focus on humanizing the chatbot did not necessarily result in higher user enjoyment (Rietz et al. 2019). Rather, they show that the users were likelier to accept a chatbot based on utility rather than hedonism or joy. Thus, in work environments, the most important element for chatbot acceptance seems to be the benefit provided.

Furthermore, some studies have explored the usability of chatbots. One such study measured the usability of a chatbot after using it for three scenarios and reported first insights into task feasibility, language comprehension, and visualization (Meyer von Wolff et al. 2020d). The results highlighted a high usability rating for the given chatbot. In particular, the study emphasized that the applied chatbot was easy to learn and understand, as well as quick and efficient in solving tasks without unnecessary effort. A similar study was followed by HOLMES ET AL. (2019) who compared the three usability measures *System Usability Scale*, *User Experience Questionnaire*, and *Chatbot Usability Questionnaire*, while also determined the respective task completion time for the evaluation setting. Besides highlighting rather high usability scores that were independent of the respective usability measures, the results showed that all three metrics were suitable in principle.

Lastly, some literature reviews about chatbot evaluations in scientific contributions exist for educational settings (Hobert 2019a), and general chatbot evaluations (Maroengsit et al. 2019). Also, SHAWAR/ATWELL (2007b) point out measurement metrics to evaluate chatbots.

Regardless, the current research mostly targets design aspects or closely related topics. Thus, to the best of our knowledge, no studies exist that examine or measure the effects of chatbots on a comprehensive level taking into account both the individual perspective as a necessary precondition and the organizational level to identify a business value. In particular, the literature neglects factors such as whether business processes can be mapped and how comparable chatbots are to current enterprise processes and systems. Hence, the applicability and usability of chatbots are rather undefined for business processes. Especially, current evaluations predominantly refer to individual aspects, which suggests that future evaluations should examine several aspects together to achieve a comprehensive understanding of the relevant effects and influences. Particularly for the enterprise context, it is not sufficient to take into account only the users' perspective because business values must be generated at the same time. Otherwise, chatbots will not even be considered by companies as a possible solution. Thus, we built upon the present scientific findings and holistically evaluated the developed chatbot from both user and organizational perspectives.

6.3 Applied Design Science Research Approach

To address our overall research aim of surveying the application of chatbots for business processes, we conducted a *Design Science Research* (DSR) study structured along the proposed publication pattern of GREGOR/HEVNER (2013) to ensure a clear and high-quality presentation of the results. In doing so, we contribute with: (1) a prototypical process-based chatbot artifact (RQ_61), (2) insights on the users' attitude towards using chatbots to conduct business processes (RQ_62), (3) a survey of the business value of process-based chatbots for business processes (RQ_63), as well as (4) first generalizable implications for process-based chatbots to extend the scientific knowledge base. As the *Design Science Research* approach, we applied the three-cycle DSR procedure of HEVNER (2007) and HEVNER ET AL. (2004) consisting of rigor, relevance, and design cycle (see Figure 33).

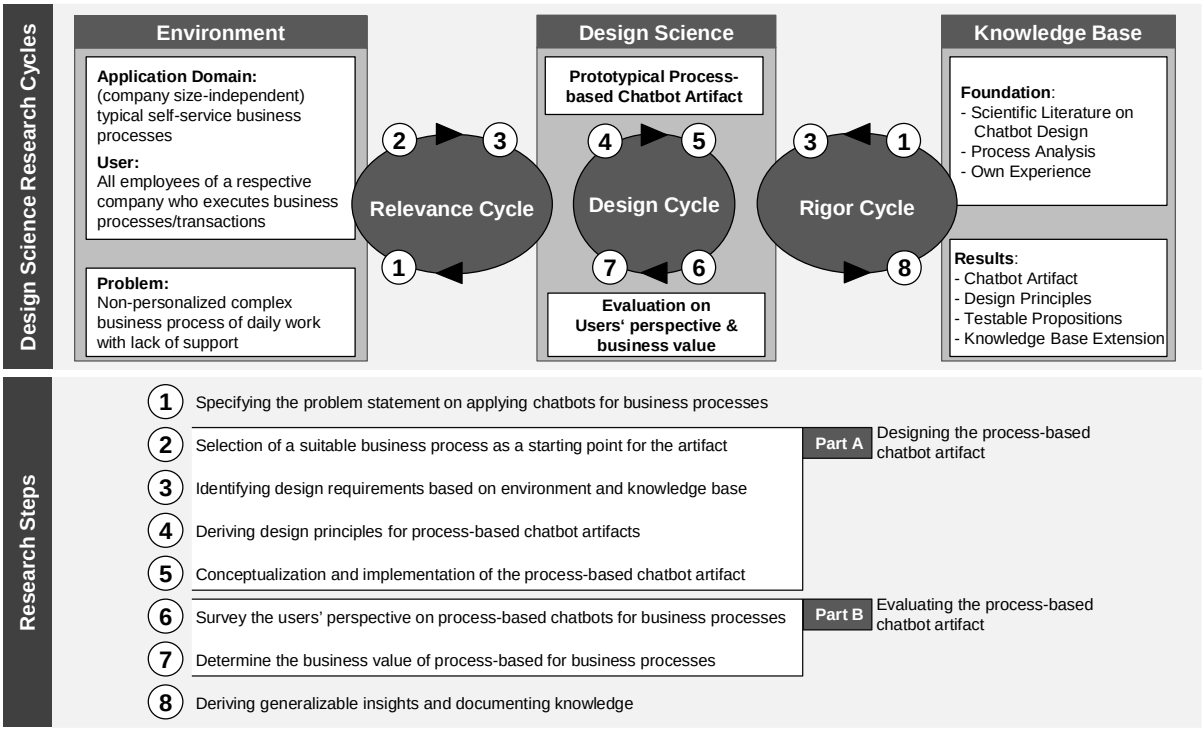


Figure 33 Applied Design Science Research Approach of Study VI

To address the *relevance*, *rigor*, and *design cycle*, we divided our research project into eight steps (see Figure 33):

We ① examined the current problem of insufficient user support for business processes and the use of chatbots in conducting business processes. For this, we derived the research problem as outlined in the introduction.

Afterward, we designed our process-based chatbot artifact (**Part A**). For this, we ② selected a suitable business process as a basis to conceptualize and develop the chatbot artifact, namely the business travel organization process. Therefore, ③ we surveyed the environment and knowledge base to identify the design requirements for process-based chatbots. For this purpose, we took into account (a) users' experiences with current processes, (b) the selected exemplary process itself, as well as (c) the current scientific literature on chatbot design. Based on these design requirements, we ④ derived design principles for process-based chatbots for conducting business processes according to GREGOR ET AL. (2020). Upon these design principles, we ⑤ developed our process-based chatbot DSR-artifact. Therefore, we selected an existing business travel organization process as an example and implemented a fully functional prototype.

Following this, we evaluated our implemented artifact in a real-case scenario based on an experiment with 69 participants out of three groups (**Part B**). For this, we first ⑥ surveyed the users' perspective in terms of user experience, system design, and acceptance. As promising results were achieved, we ⑦ further analyzed the business value of the process-based chatbot artifact in terms of its process efficiency and quality.

Lastly, we ⑧ documented the results in this contribution and derived generalizable findings using the components of a "*design and action*"-design theory as proposed by GREGOR/JONES (2007).

6.4 Designing the Process-based Chatbot Artifact

In the following, we outline the results of the first part of the *Design Science Research* approach with the aim of designing a chatbot artifact capable of executing and supporting business processes (*$RQ_6 1$*). This artifact will be used for the user- and business value-focused evaluation.

6.4.1 Scenario Description – The Business Travel Organization Process

This research aims at supporting business processes at the digital workplace. In prior research, it has already been shown that chatbots are suitable for supporting self-service functions in business applications (Meyer von Wolff et al. 2020a). As self-service is a large area in today's business, we need to select a suitable exemplary process. For this, we sought a typical company-independent process that is regularly or frequently conducted by employees to allow scalability and generalizability. Therefore, the process needed to be standardized to a certain extent so that the single tasks or steps could be defined beforehand and also enable some individualization depending on the users' input to allow individualized adaptation by the chatbot. The process has to, if possible, involve multiple stakeholders and require mandatory accurate information to reflect a realistic corporate situation. Furthermore, the process needs to mainly be in the responsibility of the person carrying it out, as this person had to then find solutions if they became stuck. Considering the criteria, we used the business travel organization process as an example process. In general, this process was standardized and formalized with defined parameters while simultaneously allowing for some degree of dynamic behavior (e.g., the order of inputs, and the use of necessary or unnecessary inputs based on the individual travel setting). Thus, it covered a typical business process that is often handled nowadays by self-service systems. Also, the process exists in almost every company in the same or a comparable form, which further enabled the generalizability of our results in general and of our design principles in specific.

To develop our chatbot, we used the current business travel organization process of a German university as the exemplary process. As of now, the process can be executed by filling out two PDF-forms (one for application and one for accounting), or using a web application that digitally represents the form (see Figure 34, left). Usually, the process starts when an employee plans an upcoming trip. Then, the employee creates a travel request using the PDF-form or the web application. If employees have a question, they have to contact the responsible support person or derive the corresponding information from the official support documents on their own. The completed application is then forwarded to the administrative assistant for review. Based on the results, the form is returned if errors are present, or forwarded to the responsible supervisor if no errors are present. Notably, different supervisors are responsible for approving the application depending on the travel location (e.g., national or international destinations) and duration. After the journey, the traveler must account for the business trip according to the same principle. Besides, receipts for the costs incurred must also be attached. As outlined, this current process has many possibilities for improvements: (1) As the user fills out the PDF, there is no individualization or adaptation to the user. Thus, unnecessary data could be queried. (2) The validity of the entered information is only checked by the user. Hence, incorrect information is only noticed late in the process when a supervisor manually checks the input, which leads to a delay due to correction. (3) In

the case of the PDF-version, both forms must be printed out before they can be forwarded. (4) However, paper-based receipts must always be submitted. (5) Additionally, no automatic forwarding exists. Those involved must first identify the responsible person and then manually pass on the form. (6) Lastly, if a user encounters problems or needs further information they have to handle this on their own. Often the necessary solutions are distributed in different systems or must be requested from other employees, which delays the process or prevents others from doing their work.

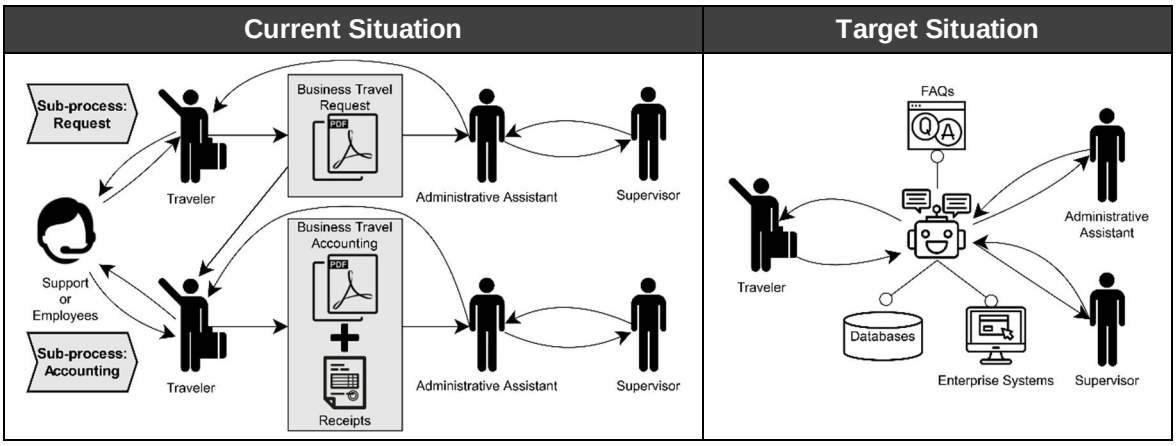


Figure 34 Exemplary Scenario: (left) Current Situation; (right) Target Situation

To overcome the obstacles and adapt the process to the user, we designed and implemented a chatbot for the business travel organization process. As outlined in the introduction and the related research section, we wanted to provide a system that requires no training to be used and can directly assist users if questions arise. In our target situation, the user should only need to communicate with the chatbot to perform both sub-processes (see Figure 34, right). The chatbot itself should adapt the necessary input fields according to each user's data and provide information in the case of questions. Upon completion of all entries, the system should forward the process to the responsible persons (e.g., the supervisor or the administrative assistant), and forward the information to the other databases and enterprise systems of the process.

6.4.2 Requirements Analysis to Derive Design Principles for Process-based Chatbots

To derive design principles for process-based chatbots, we took both environmental aspects (*relevance*): (1) Input from employees who carry out business processes, and (2) the selected exemplary process itself; as well as (3) the current scientific knowledge base (*rigor*) into consideration. To address the *relevance*, we (a) incorporated the employees and users of the selected business travel organization process into our analysis to consider expertise and experiences as well as the challenges they face when conducting the process. Also, we (b) analyzed the given process to identify its specifics and the requirements for a chatbot-based solution. To address the *rigor*, we used the AIS electronic database and included current literature on chatbot design that documented the design based on requirements or design principles. These findings were then categorized to obtain scientific design requirements for process-based chatbots. Finally, we used the user stories, the process analysis, and the scientific requirements to deduce generalized design principles for the development of a process-based chatbot according to HEVNER ET AL. (2004) and HEVNER (2007) (see Figure 33).

User-Stories for Conducting Business Processes

Based on the users' experiences with the business travel organization process, we first derived four relevant **user-based requirements** (US_i) for the chatbot artifact (see Table 36). These user stories were directly related to individuals who had organized their own business trips and the challenges in doing so. Firstly, employees, especially new ones without expertise in the process, have to *understand the underlying process and required inputs* [**US_1**]. Secondly, employees have to *fill out the form completely and without errors* [**US_2**]. Otherwise, the process or their results are either rejected or the process needs to be started again, resulting in unnecessary process cycle times and frustration. Extending this, individual *employees are responsible for the processes and their respective inputs* [**US_3**]. Despite the use of standardized processes, the employees expressed that there are usually also rules in the processes or individual paths and combinations that need to be considered. Lastly, if employees encountered problems, they have to *manually search for solutions* (e.g., FAQs or supporting documents), must contact the support staff, or ask other employees for their advice and support [**US_4**]. Whereas all of this interrupts and delays the process and, especially the latter in particular, leads to distraction from work.

Business Travel Organization Process Characteristics

To derive the **characteristics of the business travel organization process** (P_i), we conducted a process analysis. We used both forms (business travel request and business travel accounting) and all supporting information and documents, e.g., regulations on an overnight stay, resulting in seven process characteristics (see Table 36). First, the process is strictly *standardized with defined inputs* [**P_1**]. The *inputs,* however, *vary* [**P_2**] since some fields are mandatory (e.g., destination and dates), some are optional (e.g., declaration of accompanying persons), and some are conditional (e.g., demand for discounts on transportation). Second, as of now, the process is conducted with either paper forms or an application system that digitally maps both forms. Thus, employees must *review their inputs manually* [**P_3**]. For the accounting sub-process in particular, employees have to *submit paper-based receipts* for the incurred costs in addition to the accounting form [**P_4**]. Besides this, if questions or ambiguities arise, the *employee must contact a third party or look for solutions* in the available documents and information sources [**P_5**]. In addition, depending on the destination, different supervisors are responsible for approving the forms (e.g., one for domestic travel and another for international travel). Thus, *multiple actors are involved*, and *employees must forward the process* to the correct subsequent one [**P_6, P_7**].

Scientific Requirements for Process-based Chatbots

Based on the **current scientific knowledge**, we deduced 11 design requirements (R_i) (see Table 36; see Appendix A6.1 for the detailed distribution). First, chatbots should *adaptively guide users during a process or task toward a given goal* [**R_1**]. Hence, chatbots should encompass a goal-oriented behavior and actively pose questions to continue the conversation flow, use clarification and confirmation messages, or change the length, segmentation, and content of their messages based on the given situation (Feine et al. 2020a; Tavanapour et al. 2019). In doing so, chatbots should assess the current state and decide which path should be followed and which steps, depending on the given inputs or

decisions, must be conducted. If needed, step-by-step guidance should be implemented (Hobert 2019b). Thus, the systems must be able to adapt the process, or itself to the actual needs and the current state of the process. Therefore, it is necessary to actively monitor the process and the given or missing inputs (Elshan/Ebel 2020). Hence, the conversation should contain more than simple question-answering dialogs (Gnewuch et al. 2017), which require the mapping and implementation of a given business process with all its possible sub-paths. Second, chatbots should *provide direct support and question answering capabilities in the dialog* [**R_2**]. For this purpose, they should offer different kinds of scaffolds during task completion (Winkler/Roos 2019). When users encounter problems or ambiguities, the chatbot should provide a Q&A component to enable on-demand explanations or clarify the necessary steps (Hobert 2019b; Tavanapour et al. 2019). Hence, users can resolve errors on their own by questioning the chatbot, which may reduce the effort needed to complete the task or their need to contact others (Corea et al. 2020; Winkler/Roos 2019). Thus, chatbots should summarize necessary information, describe the conditions of the process, and offer explanations and clarifications if requested (Tavanapour et al. 2019). Furthermore, chatbots must *provide a user-friendly natural language-based user interface* [**R_3**]. As usual for chatbots, users control the available functions using natural language inputs in dialog form and receive the answers or results in the same manner. Consequently, a chatbot must understand the user's messages and extract the respective intent (Bittner/Shoury 2019; Diederich et al. 2020; Gnewuch et al. 2017). This type of interaction assumes that the system can handle typos or different languages and answer with correct grammar and pronunciation. The messages should use simple language, making them both short and understandable (Johannsen et al. 2018; Tavanapour et al. 2019). Also, the interface should provide visual input and output elements such as images, control elements, or buttons to increase efficiency or reduce the risk of input errors and thus maintain data consistency (Feine et al. 2020a). Furthermore, chatbots should *include anthropomorphic elements and social cues* [**R_4**] such as avatar, gender, typing delays, interjections, rhetorical elements, or the use of emoticons (Diederich et al. 2020; Feine et al. 2019a; Gnewuch et al. 2018; Liebrecht/van Hooijdonk 2020). Likewise, chatbots should act friendly, neutral, and empathetic to foster an enjoyable conversation in a professional setting that evokes real human contact (Diederich et al. 2020; Elshan/Ebel 2020; Tavanapour et al. 2019). Designers should ensure a balance between social cues and real capabilities, which also requires context-dependent social cues (Gnewuch et al. 2017). For this purpose, designers could include ways to predict user behavior (Corea et al. 2020). Additionally, chatbots must *verify user inputs and provide error handling* [**R_5**]. This includes, on the one hand, unrecognized user requests, which should be clarified by the chatbot, and, on the other hand, incorrect or faulty inputs and given information (Bittner/Shoury 2019; Feine et al. 2020a; Tavanapour et al. 2019). To start a conversation, chatbots should use *proactive methods in addition to their usual reactive conversations mode* [**R_6**]. Thus, chatbots can automatically notify users about changes (Bittner/Shoury 2019; Feine et al. 2020a). In addition, chatbots should also be *transparent about their available functions and be identified as a machine* [**R_7**]. For this reason, developers should set up an adequate introduction during which the chatbot introduces itself and explains its available functions (Bittner/Shoury 2019; Zierau et al. 2020). But also during the conversation or process, the chatbot should always clearly and transparently communicate its available functions (Feine et al. 2020a). Also, *continuous feedback on the given inputs* based on static and dynamic analysis of the statements and given information should

be implemented (Hobert 2019b; Lechler et al. 2019) [$\mathbf{R_8}$]. Furthermore, as proposed by WINKLER/ROOS (2019), chatbots should include *trust-enhancing elements* as proposed [$\mathbf{R_9}$]. Also, chatbots should offer the *option to on-demand and conveniently get in touch with a human employee* [$\mathbf{R_{10}}$]. Hence, in the case of a breakdown or user dissatisfaction, the chatbot should be able to contact a human for assistance or to continue the process (Corea et al. 2020; Diederich et al. 2020; Zierau et al. 2020). But even if a user does not want to go through the process with the chatbot, the chatbot should provide a human option instead (Johannsen et al. 2018). Lastly, chatbots should *save histories and user specifics* [$\mathbf{R_{11}}$]. This allows chatbots to learn from previous conversations and provide personalized suggestions (Feine et al. 2020a; Winkler/Roos 2019).

			Design Principles for Process-based Chatbot Artifacts					
			Natural language user interface	Process guidance including progress overview	Individualized adaptation of the process to the user	Context-dependent input options	Integrated help function via dialog	Automatic error handling
			DP_1	**DP_2**	**DP_3**	**DP_4**	**DP_5**	**DP_6**
Environment: User Stories	**User-Stories in Business Processes**							
	Individual understanding of the business process	**US_1**		●				
	Error-free input of all (necessary) information	**US_2**				●		●
	Processes are dependent on the user or their input	**US_3**			●			
	Individual help search, if process/inputs unclear	**US_4**					●	
Environment: Process Analysis	**Business Travel Organization Process Characteristics**							
	Standardized process	**P_1**		●	●			
	Different types of user inputs (mandatory, optional, conditional)	**P_2**				●		
	Manual review of the stated information	**P_3**					●	●
	Submission of supporting documents in paper form	**P_4**		●		●		
	Clarification of questions/uncertainties outside the process	**P_5**					●	
	Approval procedure by supervisors depending on destination	**P_6**		●				●
	Multiple actors involved	**P_7**			●			
Knowledge Base: Scientific Contributions on Chatbot Design	**Scientific Requirements for Process-based Chatbots**							
	Adaptive guidance of users towards a goal	**R_1**		●	●	●		
	Support and Q&A in the dialog	**R_2**					●	
	User-friendly natural language-based user interface	**R_3**	●			●		
	Social cues to generate humanness	**R_4**	●					
	Verification of user inputs and error handling	**R_5**						●
	Pro- and reactive conversation mode	**R_6**	●					
	Transparency about the available functions	**R_7**		●				
	(Automatic) Feedback on the inputs	**R_8**		●				●
	Inclusion of trust-enhancing elements	**R_9**		●				
	On-demand handoff to employees	**R_{10}**			●		●	
	Saving the histories and user specifics	**R_{11}**			●			

***Note**: ● Relation between Requirement and Design Principle*

Table 36 Requirements and Design Principles for Process-based Chatbots

Deriving Design Principles for Process-based Chatbots

To derive our design principles (DP_i) for a process-based chatbot artifact, we used the user-stories (*relevance*), the process analysis (*relevance*), and the scientific requirements (*rigor*) (Hevner et al. 2004; Hevner 2007). In doing so, we deduced six design principles for process-based chatbot artifacts (see Table 36). Following this, we applied the formalization method of GREGOR ET AL. (2020) to describe the design principle based on the constructs actor, aim, mechanism, and rationale (see Table 37).

First, chatbots should enable **user interaction with a natural language user interface** [DP_1; based on R_3, R_4, R_6]. Hence, chatbots require a messenger-like dialog-based form with which users can control the available functions. Depending on the input, the user's messages must be processed and interpreted to control the system and its underlying business process. Due to the natural communication behavior, the users can thus control the system intuitively without previous training. To create the perception of a real person, and foster user acceptance, chatbots should include social cues or anthropomorphic elements. Additionally, chatbots must **map the respective business process and guide users** through it [DP_2; based on US_1, P_1, P_4, P_6, R_1, R_7, R_8, R_9]. Therefore, they must implement the complete business process, all sub-processes or paths, and the relevant conditions. By doing so, chatbots can query the (necessary) information from users and decide on the next steps. To help users find their way through the process and assess their current status, chatbots should offer feedback options, such as (sub-)process/task summaries or progress overviews. In a related manner, chatbots must **individually adapt the process to each user** [DP_3; based on US_3, P_1, P_7, R_1, R_{10}, R_{11}]. Hence, to support flexibility, chatbots should not enforce strict process sequences. Rather, they should exhibit a goal-oriented behavior along all possible sub-paths or paths of the given business process. Depending on the inputs, users should only go through the necessary steps or only have to share strictly necessary information, which speeds up the process and prevents unnecessary activities. To further increase efficiency, the individualized adaption should also encompass personalized suggestions based on previous interactions or recognized patterns. Chatbots should also offer **context-dependent input options** [DP_4; based on US_2, P_2, P_4, R_1, R_3]. As usual in application systems for business processes or tasks, chatbots should allow interaction using control elements, e.g., buttons, selection options, file uploads. Users can work with their familiar elements, do not need to learn new techniques, and are not forced to write all of their inputs. Also, from a usability perspective, it is immediately obvious what the user must do. For instance, a date picker shows the user that they must enter a date. Likewise, a multiple-choice list directs the user to select the suitable option. Additionally, this design principle further enhances data quality and consistency because the information is already pre-formatted, which ensures that the data can be further processed without errors. Furthermore, chatbots should **encompass an integrated help function in their dialog** [DP_5; based on US_4, P_3, P_5, R_2, R_{10}]. If the user encounters problems or ambiguities, they can directly ask the chatbot for help. Accordingly, chatbots need Q&A components where typical questions are addressed. Thus, the dialog is not interrupted, and users do not need to search for solutions manually or in another system. Also, this component prevents other employees from being distracted from their work and reduces the volume of questions. Thus, users are not dependent on third parties, the process is accelerated, and the risk of incorrect entries is reduced. Coincidently, chatbots must **promote the use of correct information** [DP_6; based on US_2, P_3, P_6, R_5,

R_8]. Especially in business processes, users must provide error-free and complete information, as subsequent tasks or processes are based on them. Otherwise, further errors or aborts occur, resulting in delays or process restarts for users.

Design Principle	Description
DP_1: Natural language user interface	For chatbots to provide user-friendly humanized user interfaces that can be used responsively and device-independently with the feeling of a personal contact for employees in digital workplace settings, employ a natural language user interface with social cues [R_3, R_4, R_6].
DP_2: Process guidance including progress overview	For chatbots to enable individualized processes that can be carried out without prior knowledge by employees in digital workplace settings, employ a natural language-based step-by-step process guidance that encompasses the entire process and enables successful process execution, as well as a progress overview that indicates current status [US_1, P_1, P_4, P_6, R_1, R_7, R_8, R_9].
DP_3: Individualized adaptation of the process to the user	For chatbots to allow flexibility in process execution and support a user-centered design for employees while executing business processes in digital workplace settings, employ the corresponding business process in a goal-oriented behavior with all possible tasks and enable individualized pathing based on user' inputs while also using previous inputs as suggestions [US_3, P_1, P_7, R_1, R_{10}, R_{11}].
DP_4: Context-dependent input options	For chatbots to offer a range of functions adapted to dialogs and comparable to classic enterprise systems as well as to enhance data quality due to a preformatted structure for employees in digital workplace settings, employ various suitable context-dependent input options [US_2, P_2, P_4, R_1, R_3].
DP_5: Integrated help function via dialog	For chatbots to provide support during the task and provide solutions for ambiguities and misunderstandings directly at the time of emergence for employees while conducting business processes in digital workplace settings, employ an integrated help function or Q&A component in the dialog where users can ask questions and get support by the chatbot [US_4, P_3, P_5, R_2, R_{10}].
DP_6: Automatic error handling	For chatbots to ensure that all necessary entries/information are made and correct, so that the process is not interrupted or delayed by employees in business processes in digital workplace settings, employ an automatic error handling to verify inputs and check for completeness for troubleshooting [US_2, P_3, P_6, R_5, R_8].

Table 37 Design Principles for Process-based Chatbots according to GREGOR ET AL. (2020)

6.4.3 Description of the Process-based Chatbot Artifact

Based on the design principles (see Table 37) and state-of-the-art chatbot architecture (Berg 2014; Mallios/Bourbakis 2016), we developed our process-based chatbot artifact for the business travel organization process (Meyer von Wolff et al. 2021a) (see Figure 35). The user interface was developed with common web technologies (*HTML5*, *JavaScript*, and *jQuery*), enabling a responsive layout. The chatbot itself is based on *Node.js*, *TypeScript*, and *Rest-APIS*, while using the *NLP.js* framework for natural language processing [DP_1]. To provide the process functionalities, we used a finite state machine per sub-process: three general states, 69 states for the request process, and 80 states for the accounting process. Based on the results of the NLP, the system determines the correct state and the corresponding necessary inputs, decides the next steps, and/or adapts the dialog to the individual user and the previous inputs [DP_2, DP_3].

The main user interface is structured based on typical messenger-like systems and supports mobile use through responsive design (see Figure 35) [DP_1]. As typical, the user has access to a menu for the logout and some control elements on the top left (1). Besides this, the progress in the current sub-process (2) is shown on the top as well as on the right in the desktop view [DP_2]. In doing so, all necessary input categories are listed and colored green if an input was made. On the bottom of the window, the typical chatbot input bar is placed (3). Here the user can enter the required inputs and control the process or system, e.g., the user can type "*return*" or "*back*" to jump back one input or "*cancel*" to stop the current (sub-)process [DP_1]. After a user logs in, the chatbot introduces itself, explains its

purpose (4), and lists current notifications [DP_1]. After entering an input, the chatbot queries the subsequent steps or necessary inputs (5). For this, the chatbot passes the finite state machine and adapts the process based on the user's inputs [DP_2, DP_3]. Figure 36 displays a dialog snippet (left) and its underlying finite state machine (right) for some steps in the business travel request sub-process. Also, if the user does not make any entries for a certain time, the chatbot asks if everything is okay to generate attention (6). The users can also ask questions at any time if something is unclear or if further information is required [DP_5].

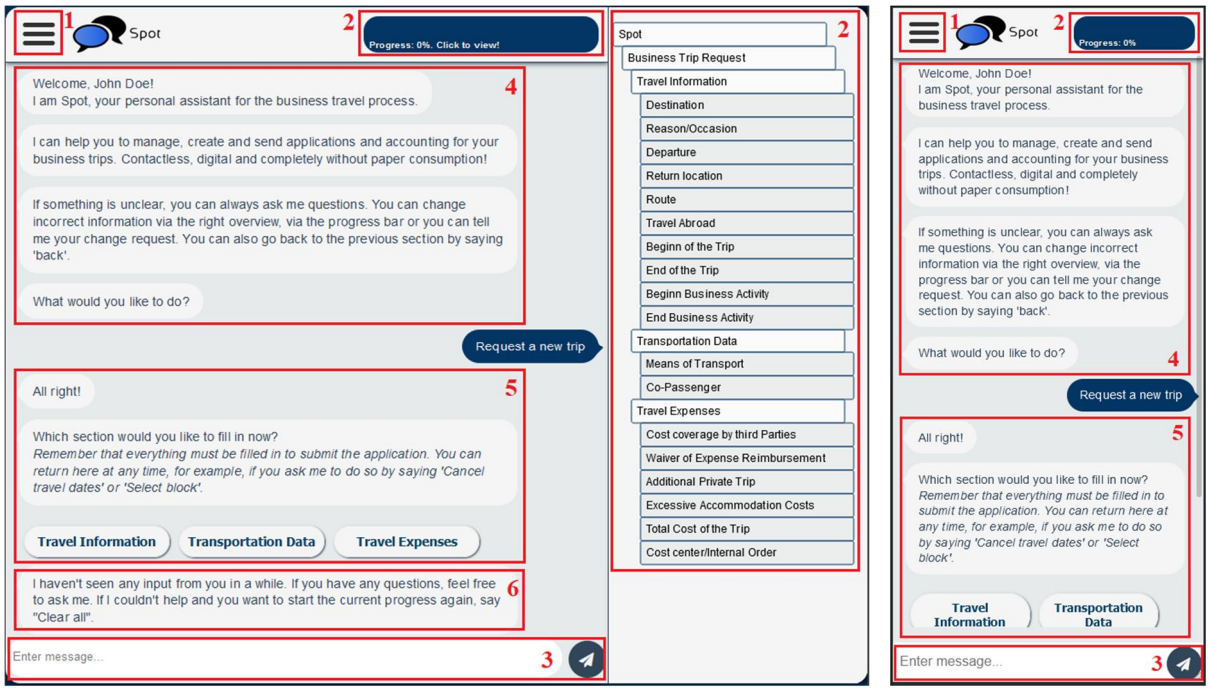


Figure 35 User Interface: (left) Desktop View; (right) Mobile View

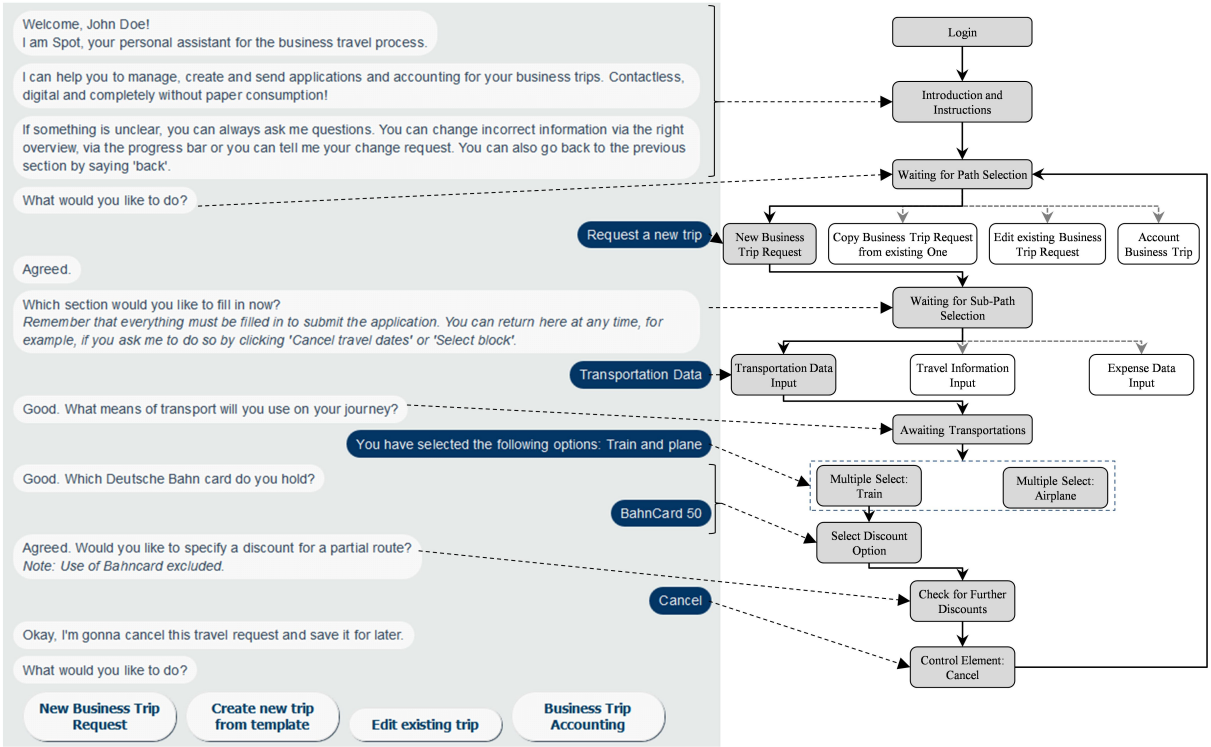


Figure 36 (left) Exemplary Dialog Flow; (right) Corresponding Finite State Machine Excerpt

Furthermore, besides the natural language input, we implemented several alternative input options [DP_4] to give users as much flexibility and efficiency as possible and that they are not forced to write everything. In doing so, the options should also reduce the susceptibility to errors, as information is entered in a pre-formatted form. Thus, depending on the necessary information, the user can use the following alternative input options (see Figure 37): (A) Typical text input by writing commands or necessary inputs in a messenger-like environment; (B) If the user can choose between a set of options: the user can use the corresponding quick-reply element or type an answer; (C) The users can choose from multiple selection list when they must make a selection of specified elements; (D) The user can use a date picker to select dates and times; (E) The user can provide receipts by attaching a file directly in the dialog window or, in the case of mobile usage, taking a photo; and (F) The user can confirm and sign the request and accounting forms in the dialog.

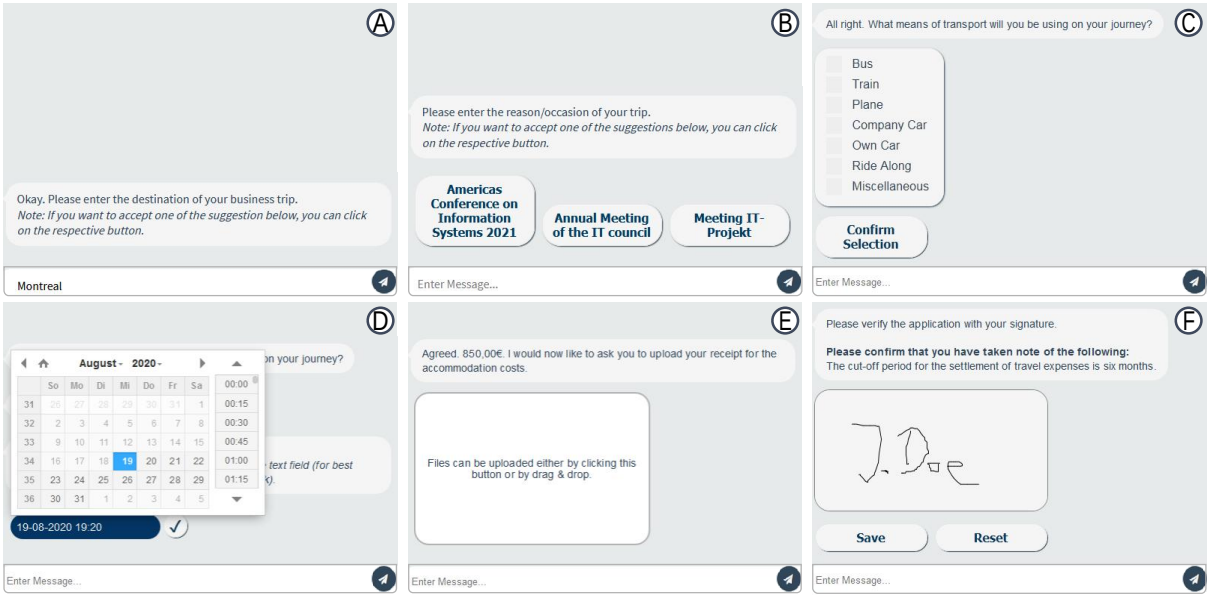


Figure 37 Input Options: (A) Text; (B) Quick Replies; (C) Multiple Selection; (D) Date Picker; (E) File Upload; (F) Signature Box

6.5 Evaluating the Process-based Chatbot Artifact

After we could successfully develop a process-based chatbot, it is necessary to evaluate the concept to determine its effects and how users would perceive it. Therefore, we looked at the situation from two perspectives. On the one hand, it is necessary to check how users assess the concept and whether there is acceptance, as this group is largely responsible for chatbots' success and usage (RQ_62). On the other hand, we need to determine a potential business value to justify an application at the company level. Otherwise, if there is no added value, companies will not even consider chatbots for business processes (RQ_63). Consequently, process-based chatbots can only be successful if both the concerns of users and businesses are met.

6.5.1 Experimental Evaluation Approach

To survey the individual (RQ_62) and organizational perspective (RQ_63) of the application of our process-based chatbot, we conducted a two-stage experimental evaluation approach with participants from three distinct user groups (see Figure 38).

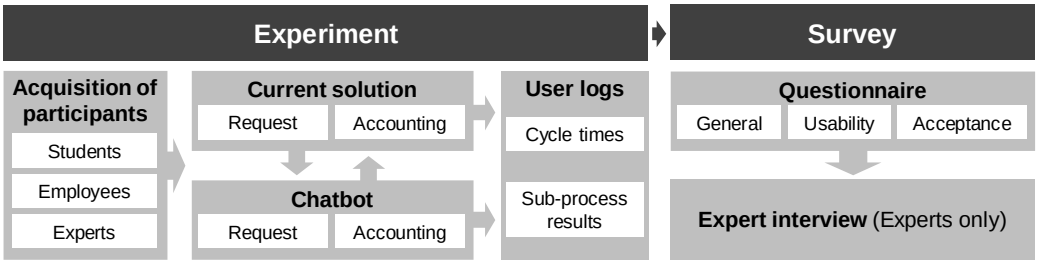


Figure 38 Evaluation Design of Study VI

For the **experiment**, we acquired the participants based on three distinct groups (see Figure 38): (1) Students, with little to no experience in using the sample process, as the group of novice employees; (2) Experienced employees, who have experience with the sample process or similar processes and would be confronted with a possible system change; and (3) Experts, dealing with workplace (re-)design or practical application of chatbots, who can give practice-oriented insights from projects and who potentially have decision-making authority. In the experiment, the participants used both settings the current PDF form and the chatbot.[24] Each participant got a case for each setting as the evaluation scenario to be able to compare the form and the chatbot with each other. In each of the cases, the participants were given the task of requesting a business trip (SP1) and completing the accounting (SP2) for it. The tasks differed in content between the settings but were structured in the same way. The experiment was controlled using the groups: all students and half of the employees used both the PDF form and the chatbot; the other half of the employees and all experts used the chatbot only, and the experts also carried out only one of the two sub-processes. We randomized the assignments and the order of the settings to prevent biased results. Lastly, we documented the sub-process results and the cycle times for each participant to compare the current form method and the chatbot in terms of their efficiency and quality (i.e., error rates).

Following the experiments, we conducted an **evaluation survey** (see Figure 38). For this purpose, all participants filled out a questionnaire about each setting they had in the experiment (see Table 38; see Appendix A6.4 for the detailed and Appendix A6.5 for the applied questionnaire; the questionnaire for the current PDF form only included the usability part in terms of the *User Experience Questionnaire*. (A) We used some general questions to classify the participants and their results. (B) To measure the usability of process-based chatbots, we included the *User Experience Questionnaire* (UEQ) (Laugwitz et al. 2008; Schrepp et al. 2017), a standardized and simple measure for user experience based on 26 items grouped into six scales: attractiveness, perspicuity, efficiency, dependability, stimulation, and novelty. In addition, an assessment of our derived design principles was made to verify them. (C) To address the importance of users accepting the process-based chatbot and feeling satisfied with it, we included the *Technology Acceptance Model* (TAM) (Davis 1993) and the

[24] See Appendix A6.3 for the two evaluation scenarios for the form and the chatbot.

Information Systems Success Model (ISSM) (DeLone/McLean 2003) which to be able to use the established and accepted measurement items for the questionnaire development. Based on a comparison of current TAM and ISSM questionnaires available in the scientific research and an analysis of the fit of the items to our research goal, we included the core constructs from the TAM and extended them with three constructs from the ISSM, which were measured with three to five items. Lastly, we briefly interviewed the experts on subjects such as the chatbot's fit for practice applications, system features, and challenges to obtain more detailed information.[25]

Part	Construct	Items	Type	Reference
(A) General	Age	1	Free text	
	Gender	1	Single Choice	
	Chatbot experience	1	5 point-Likert	
	IT-affinity	9	6 point-Likert	(Franke et al. 2019)
	Process experience	1	Single Choice	
(B) Usability	System features	6	7 point-Likert	
	User experience	26	7 point-Likert	(Laugwitz et al. 2008; Schrepp et al. 2017)
(C) Acceptance	Information quality	4	7 point-Likert	(Freeze et al. 2010; Yu/Qian 2018)
	Service quality	4	7 point-Likert	(Alshibly 2014; Ojo 2017)
	Perceived usefulness	5	7 point-Likert	(Davis 1989; Venkatesh/Bala 2008)
	Perceived ease of use	5	7 point-Likert	(Venkatesh/Bala 2008; Venkatesh/Davis 2000)
	Behavioral intention to use	3	7 point-Likert	(Constantinides et al. 2013; Venkatesh/Davis 2000)
	User Satisfaction	3	7 point-Likert	(Alshibly 2014; Freeze et al. 2010; Yu/Qian 2018)

Table 38 Evaluation Questionnaire of Study VI

6.5.2 Sample Distribution

Based on the evaluation design, we recruited 69 participants (see Figure 39), whereas ~40 % were students, ~42 % were employees, and ~19 % were experts. Thus, 46 participants represented actual future users, while 13 participants represented the management's perspective (see Appendix A6.2 for the industry of the experts). Most participants were male (~60 %), but across the student and employee groups, the ratio was equal (28 female, 28 male). On average, the participants were roughly 30 years old, which may have been due to the high proportion of students and younger employees. Nevertheless, we were able to attract at least one participant from all age groups. Also, the IT-affinity (Franke et al. 2019) of our participants was rather high (*mean*=4,38), possibly due to today's increasing digitalization and the growing preoccupation with digital and IT-technologies. Regardless, the complete range was covered. Furthermore, ~50 % of our participants knew the current business process, while ~23 % knew similar processes. Only ~28 % had no previous experience with the process. Lastly, most participants (~57 %) had used chatbots on an occasional basis, while ~28 % had less to no experience with chatbots. Around 14 % had frequent to regular usage experience. Thus, we achieved a good cross-section of the targeted population with our participants.

[25] See Appendix A6.6 for the applied semi-structured interview guideline.

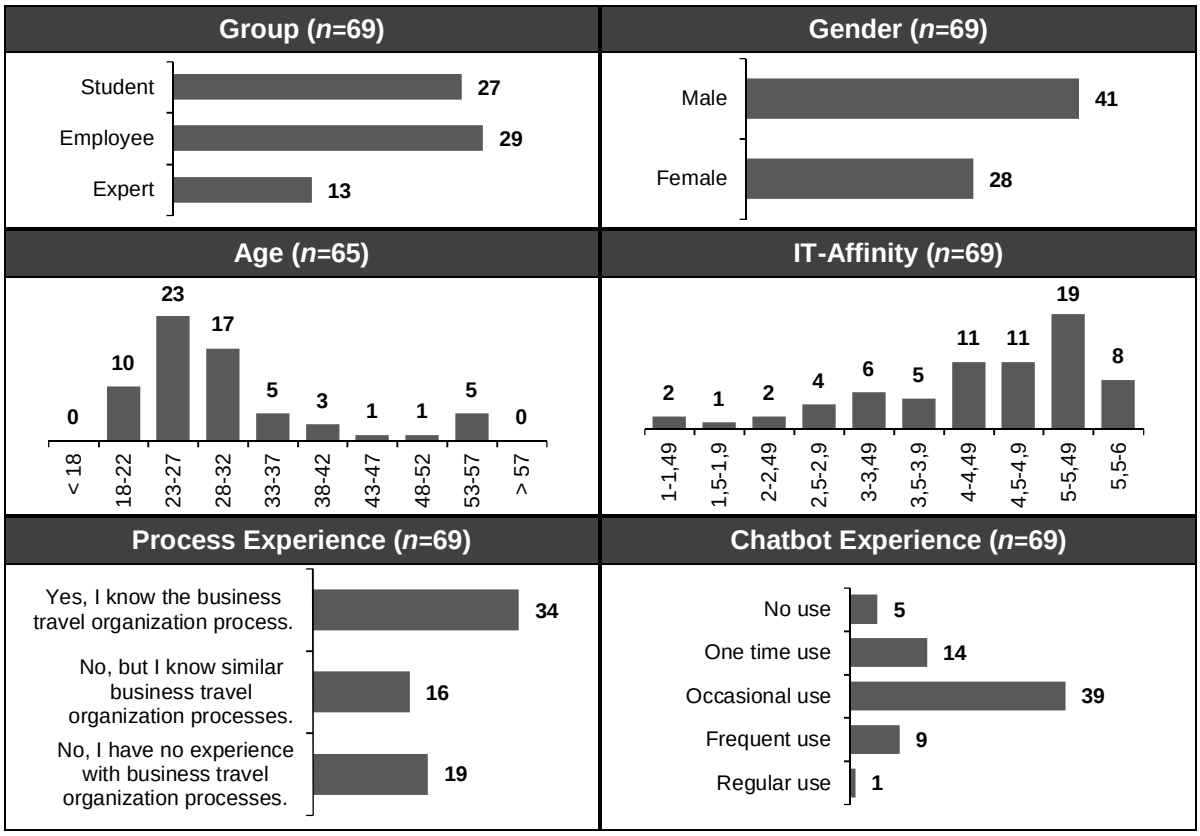


Figure 39 Sample Distribution of Study VI

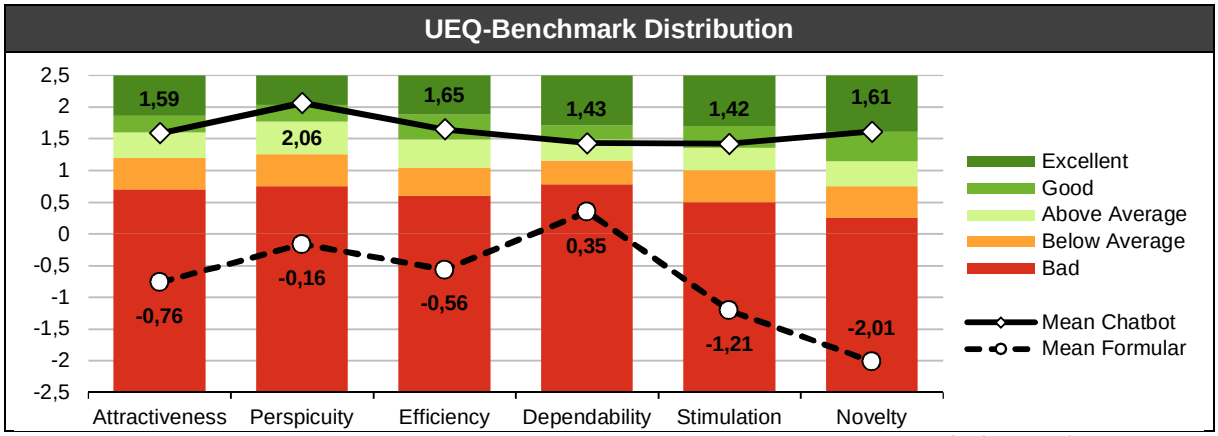
6.5.3 Users' Perspectives on Using Chatbots for Business Processes

Regardless of a possible business value, the decisive success of a system depends above all on the future user ($RQ_6 2$). Therefore, it is necessary to consider this perspective as a precondition. A potential usage can only be assumed if the system matches users' expectations and achieves acceptance. Consequently, we assessed the usability and design of our chatbot from the users' perspectives and determined their acceptance of this new solution for the business travel organization process.

Usability of Chatbots for Business Processes

As the first users' contact point with the chatbot system and the provided functionalities is the user interface of the chatbot, its user experience has to be surveyed in detail first. Specifically, we assessed the user experience in terms of *attractiveness*, pragmatic quality (*perspicuity*, *efficiency*, and *dependability*), and hedonic quality (*stimulation* and *novelty*) based on the *User Experience Questionnaire* (UEQ), which contains 26 items measured with 7 point-Likert scales (see Table 38) (Laugwitz et al. 2008; Schrepp et al. 2017). This approach was already applied successfully for other chatbots (e.g., Holmes et al. 2019; Meyer von Wolff et al. 2020d). Except for the missing values, we analyzed the data set with the official analysis tool and removed suggested suspicious data sets, which were identified by the difference between the best and worst evaluation of an item. This resulted in 66 datasets for the chatbot and 35 data sets for the current method. Additionally, we compared our results with the official UEQ benchmark data set of 452 UEQ-studies (Schrepp et al. 2017).

Overall, the participants rated our artifact substantially higher than the current system (see Figure 40, top; axis dimensions reduced from -3/+3 to -2,5/+2,5; see Appendix A6.7 for item distributions and scale consistencies). Notably, the artifact achieved excellent values based on the official benchmark, especially for *perspicuity* (*mean*=2,06) and *novelty* (*mean*=1,61). Thus, the artifact was perceived as easy to learn and to understand, as well as creative or innovative. Nonetheless, also the *efficiency* (*mean*=1,65), e.g., fast and efficient in solving tasks without unnecessary effort, and *stimulation* (*mean*=1,42), exciting and motivating artifact, was perceived as good. Therefore, the results confirmed the basic chatbot idea. Instead of users having to search for solutions and instructions themselves, and experiencing problems like information overload due to the many available systems and sources, a chatbot provides a single answer or can guide through processes in a natural dialog. However, the participants rated a*ttractiveness* (*mean*=1,59) and *dependability* (*mean*=1,43) as the lowest of the aspects. These values were only above average from the benchmark's perspective. In contrast to the quite good chatbots' rating, the participants rated all aspects of the current method as bad. Notably, only *dependability* (*mean*=0,35) had the only positive value. Thus, from user experience, the chatbot is nowhere worse than the current one and can, therefore, both keep up with the previous one and even implement the process in a much more appealing way. Hence, the chatbot is more likely to be used from a user experience perspective than the current solution.



***Note**: Chatbot n=66 | Current n=35*

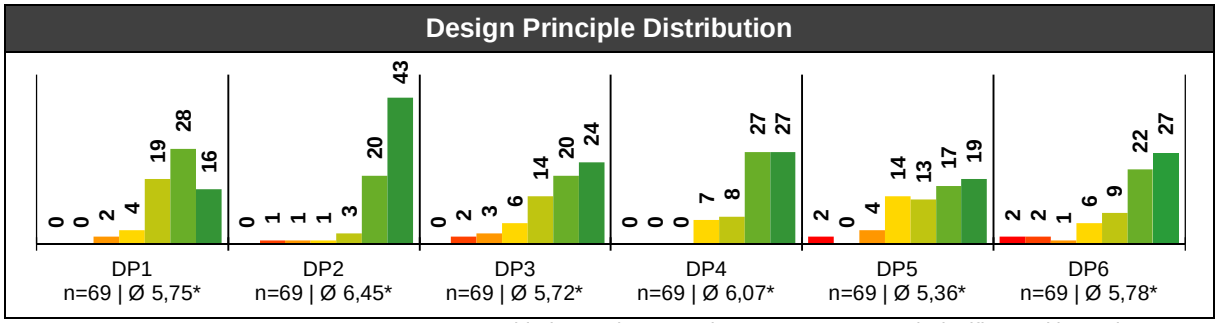
Figure 40 UEQ Distribution including the Official UEQ Benchmark (Schrepp et al. 2017)

System Design of Chatbots for Business Processes

Further, we evaluated our six design principles for process-based chatbots with 7-point Likert scales (1: very negative; 7: very positive) and tested whether the results differed significantly from the Likert scale's mean using a one-sided t-test (see Figure 41).

Our results showed that all design principles were rated positively and all average values were significantly different. In particular, *process guidance* [DP_2] (*mean*=6,45) and *context-dependent input options* [DP_4] (*mean*=6,07) were assessed positively. Thus, the results revealed that process guidance combined with suitable input options, depending on the respective required information, is viable for process-based chatbots. Also, the *automated error handling* [DP_6] (*mean*=5,78), *natural language user interface* [DP_1] (*mean*=5,74), and *adaptation of the process on the individual user* [DP_3] (*mean*=5,72) seemed useful for a process implementation in the current form. However, the *integrated help*

function [DP_5] (*mean*=5,36) could be improved in the current version, even though this value was already above the mean and still rated good.



***Note**: *one-sided t-test (presumed mean$_{(normal\ distribution)}$=4) significant with p-value <0.01*

Figure 41 Evaluation of the Design Principles

Design Principle	Exemplary Quotes
DP_1: Natural language user interface	"*for a chatbot that has to be the case*" "*It is helpful because it translates what it actually does into my language. [In processes] are a lot of things and I don't really care what's behind them. But what I want is someone to ask me when did you leave, what did it cost, and so on*"
DP_2: Process guidance including progress overview	"*It takes away the problem that I forget something, that I do something wrong, and that in the end, the person who gets it is satisfied with the result, […] without me having to think about what I actually have to do. So it makes the task easier, that I get these guidelines"* "*what always annoys me about chatbots […] is that I don't know where I am actually in my process [...]. What it did well was that I had this organizer on the right. I always knew this is the structure […] and I can follow this structure and the chatbot actually just supports me in filling out these individual things*"
DP_3: Individualized adaptation of the process to the user	"*the chatbot already knows something about me and saves me work and effort*" "*characteristics where patterns happen in my preference [...] I think they can be recognized and suggested to me next time […] as a preference*"
DP_4: Context-dependent input options	"*that's what the user expects and also takes away a bit of this cognitive load, [...] it guides me much better. [...] I see that and I know immediately what I have to do. The task is just intuitively clear to me*" "*I also have these things with a normal web form [...] and if you now only offer chat, because that's cool [...] that's super inefficient and it has to be broken up as often as possible. Ideally, the chatbot knows exactly what I want and it only asks me questions and I say "Yes". Since this is not possible in its entirety, […] support me with intelligent input options […] that I don't always have to write text.*"
DP_5: Integrated help function via dialog	"*if questions arise they are answered as briefly and concisely as possible and very quickly and also in the immediate context of the process support of the tool. [...] Preferably still in the dialog*" "*you are in a process right now and need this knowledge now. The knowledge is already somewhere else. I'll put it right into your process. I don't have to look in another place*"
DP_6: Automatic error handling	"*you always have a return because something is missing or because you have entered something wrong […]. This is very good at least from an IT point of view, but also for the user*" "*validations in any form help in any system, same with chatbots. It is also good if you have an NLP framework behind it, which also filters out typos and so on*"

Table 39 Exemplary Interview Quotes for the Design Principles

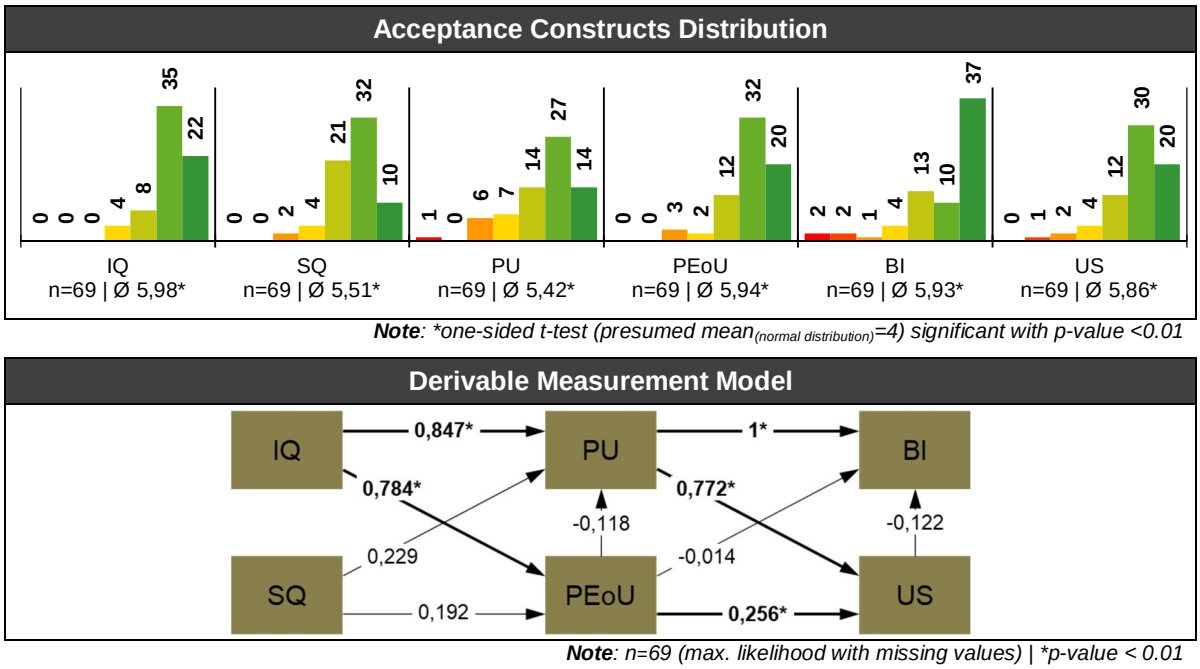
Based on the interviews with the experts, our deduced design principles for process-based chatbots (see Table 37) could also be confirmed (see Table 39). The experts considered the user interface [DP_1] to be quite useful, as users could easily and naturally run the chatbot without having to deal with the system behind it. In addition, the chatbot reduced user effort and thus allowed the users to focus on what is important. In particular, the experts reported that the overview function seemed appropriate for process-based chatbots [DP_2]. Furthermore, they asserted that the suggestions seemed viable for individualized adaptation [DP_3], allowing users to reuse previous inputs and further reducing user effort.

In addition, they confirm that input options supported users, as they showed at a glance what kind of input was required [DP_4]. Hence, users could perform functionalities faster and did not have to rely on textual input. Also, the experts agreed that if questions arose, the chatbot should be able to provide an integrated help function [DP_5]. Therefore, users can directly ask questions and get solutions or clarifications easily. Lastly, the experts supported our belief that error handling was necessary to prevent processes from being interrupted [DP_6]. Notably, speech processing can further support this by automatically correcting typos.

Acceptance of Chatbots for Business Processes

Since from the users' point of view, the applicability is influenced by the intention to use a software as well as the satisfaction with a system, it is also necessary to survey these factors to determine the probability of success of process-based chatbots. Therefore, we rely on applied measurement items of TAM and ISSM available in scientific research. In doing so, we applied the TAM constructs *perceived usefulness* (PU), *perceived ease of use* (PEoU), and *behavioral intention to use* (BI), and the ISSM constructs, *information quality* (IQ), *service quality* (SQ), and *user satisfaction* (US). During a comparison of available TAM and ISSM studies in current research, we noticed that the items representing *usage intention* and *actual use* (ISSM) were also represented in the constructs for *perceived ease of use*, *perceived usefulness*, and *behavioral intention to use* (TAM). This was also the case for *system quality* (ISSM) and *perceived ease of use* (TAM). Thus, to avoid ambiguity, we only used the TAM constructs and their items. The resulting six constructs were measured based on 24 items with 7-point Likert scales (see Table 38; 1: do not agree; 7: fully agree; see Appendix A6.4 for the detailed applied items). Furthermore, we aggregated the distributions for each item to the distribution of the constructs (see Figure 42, top; see Appendix A6.8 for a detailed evaluation of the items) and tested whether the results significantly differed from the Likert scale's mean using a one-sided t-test.

Especially, *IQ* (*mean*=5,98), *PEoU* (*mean*=5,94), and *BI* (*mean*=5,93) were rated positively. Thus, the system was able to provide relevant information, handling was easy to learn, and users would even recommend the system to others. In particular, the results for *PEoU* coincided with those for the UEQ part of the evaluation, where perspicuity was also rated quite high. From the acceptance perspective, however, the constructs of *SQ* (*mean*=5,51), *PU* (*mean*=5,42), and *US* (*mean*=5,86) were rated slightly lower but still very good. In particular, the participants criticized the support given in the case of problems, increased productivity, and conformity to expectations. Nonetheless, our results indicated a potential actual system use, as the constructs were rated quite high and, therefore, acceptance of the chatbots seemed to be present. Notably, *BI* was rated high, which indicated an acceptance by users and a high usage probability of the chatbot. Also, the overall *US* was quite high, which confirmed the positive results of the UEQ. Thus, the results indicated that the participants were rather satisfied with the process-based chatbot and reported probable future usage. Consequently, acceptance and, thus, applicability from the users' point of view seemed to have been ensured. Therefore, individual usage could be expected. A risk of non-use and, thus, a lack of applicability from the users' perspective could not be identified by our results.



***Note**: *one-sided t-test (presumed mean$_{(normal\ distribution)}$=4) significant with p-value <0.01*

***Note**: n=69 (max. likelihood with missing values) | *p-value < 0.01*

Figure 42 Evaluation of the Acceptance Constructs and the derivable Measurement Model

Additionally, based on the applied items and their constructs, we derived a measurement model with the help of the original TAM and ISSM (Davis 1993; DeLone/McLean 2003). Consequently, our proposed derived measurement model consists of our six applied constructs (see Figure 42, bottom). Grounding on the evaluation results, we could deduce first insights on the respective influences using STATA for calculating the structural equation model. Only some relations were measured significantly, which are outlined in the following. In particular, the *IQ* had a positive influence on the *PU* and the *PEoU*. Moreover, the *BI* only depended on *PU*. Lastly, *US* was positively influenced by *PU* and *PEoU*, demonstrating that a process-based chatbot can achieve user satisfaction. Since the influence of *PU* on *US* was greater than that on *PEoU*, we concluded that the capability of a chatbot to conduct the given business process in a digital workplace environment is more important than the usability aspects of the given chatbot.

6.5.4 Organizational Perspectives on the Business Value of Chatbots for Business Processes

As the users' perspective on process-based chatbots for business processes achieved quite good results in terms of usability and acceptance, an individual usage can be anticipated. Thus, it is crucial to evaluate the business value to justify their operation from an organizational perspective (*RQ$_6$3*). Regarding usability and acceptance, the pure advantage from the users' point of view, often does not justify deployment at the company level or the incurred costs. Companies are willing to adopt such technologies, only if an economic contribution can be achieved or the system is comparable with current solutions. Therefore, we measured the process efficiency and quality of our developed chatbot in terms of the lead times and occurred errors, and considered the experts' opinions on chatbot usage.

Process Efficiency: Comparison of Lead Times

To measure process efficiency, we first calculated the lead times for the two exemplary processes depending on the setting (see Figure 43, top). With exceptions for missing values, we cleansed the data

by removing the extreme outliers (> 3 × $interquartil\,range$) from each data set until only mild outliers remained (Tukey 1977), resulting in fewer valid datasets than actual participants.

The results showed that the scenario process business travel request (SP1) can be conducted with the chatbot in an equal time (*median*=12:45 min. to 12:48 min.) (see Figure 43, top). For the scenario process business travel accounting (SP2), however, the participants were faster with the chatbot by 3:20 minutes (*median*=14:40 min. to 11:20 min.). Thus, because accounting was always the second task in each setting, we assert that chatbots support a high learning effect. Notably, the mean time between SP1 and SP2 decreased compared to the current method. These results were confirmed by the total lead time. In total, the participants needed 24:45 minutes (median) for both sub-processes with the chatbot, while they needed 27:08 minutes (median) with the current method. Thus, our results indicate that chatbots can keep up with and even undercut previous lead times, especially for processes that are not (fully) digitalized as in our example.

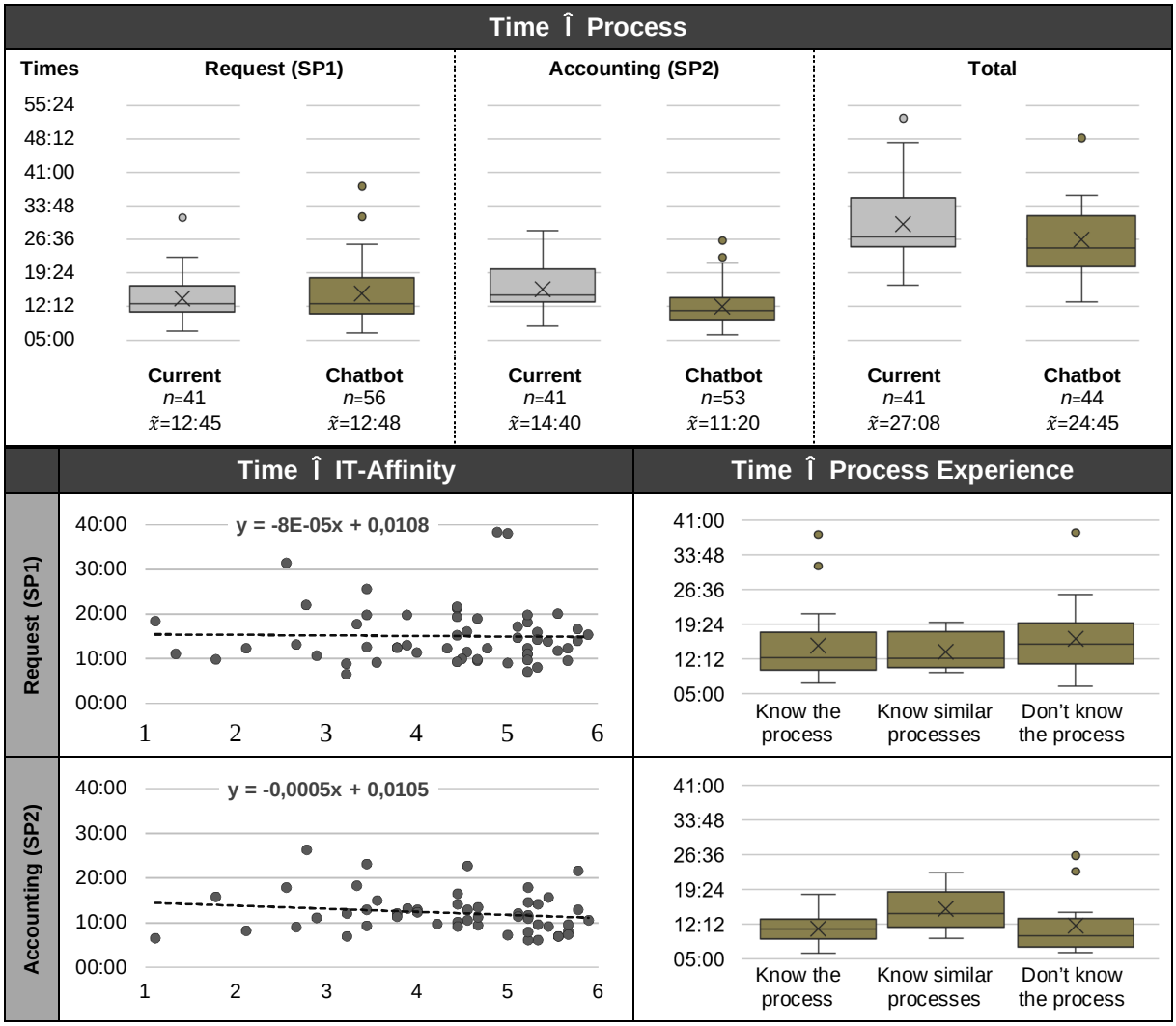


Figure 43 Lead Time Distributions

Additionally, we compared the participants' lead times with their IT-affinity (see Figure 43, bottom left). We found that IT-affinity seemed to have little to no influence on lead times. Only for SP2, a small positive influence of IT-affinity is detectable. Thus, our results showed that the participants conducted chatbot-based processes independently of their IT-affinity, which can be an advantage, especially for

new or older employees, as sources of error or frustration can be reduced. Also, our results demonstrate that no specific IT-affinity level may be required to carry out work tasks with process-based chatbots.

Furthermore, we compared the participants' experience with the process with their respective lead times (see Figure 43, bottom right). Regardless of their personal experience level, their lead times were comparable. Only participants who knew similar processes had higher lead times for the accounting task. As expected, those without previous experience had the highest lead times for SP1. Interestingly, however, their lead times for SP2 were the lowest, which further supports our statement on chatbots' learning effects.

Process Quality: Risk of Faulty Processes

To survey process quality, we analyzed the results of each setting and scenario in terms of correctness and errors, e.g., incorrect or missing entries and supporting documents (see Table 40; incomplete evaluations were removed). For SP1, the chatbot achieved more correct requests than the current method, resulting in a difference of 17,47 %. For SP2, this difference increased to 30,85 % in the chatbots' favor. In terms of erroneous processes, the chatbot reduced the number of refusals (SP1: -47,14 %, SP2: -36,10 %). However, it also increased the risks of false positives, e.g., forgotten optional inputs or erroneous entries and selections due to lack of process knowledge, which is not identifiable by automated means (SP1: ~30 %, SP2: ~5,24 %). Evidently, our chatbot could not represent the entire process, as humans were still required to check the proposals, but it did reduce the risk of fundamentally incorrect or incomplete processes. Thus, the chatbot should be further refined, and possible problems should be identified. Depending on the effort, impacts, and occurrence of the incorrect request/accounting cases these should be addressed, e.g., by (re-)design or new phrasing and different questions.

		n	Correct	Erroneous	Δ%	Thereof refusals	Δ%	Thereof false positives	Δ%
SP1	Current	41	31,71 %	68,29 %		48,78 %		19,51 %	
	Chatbot	61	49,18 %	50,82 %	− 17,47 %	1,64 %	− 47,14 %	49,18 %	- 29,67 %
SP2	Current	41	34,15 %	65,85 %		56,10 %		9,76 %	
	Chatbot	60	65,00 %	35,00 %	− 30,85 %	20,00 %	− 36,10 %	15,00 %	- 5,24 %

Table 40 Process Outcome Quality

Qualitative Reflection by the Experts

Lastly, we asked our experts (see Figure 38) to reflect on our concept of process-based chatbots for digital workplaces and assess their suitability from an actual real-case business perspective in the interviews.

Notably, all of our participating experts (*n*=13) agreed on the general suitability of our chatbot. In particular, one reported that "*nothing is really missing; I think that the way it is designed, it is also well suited for practice*". Especially, one participant presented a viable application scenario for chatbots in digital workplaces: "*[They should target processes] that quite a lot of people do, also do the same, but not frequently. So from each individual not frequently [...] that have many branches, i.e. many alternative*

paths and that you only run very rarely, that you don't get lost somewhere". In a related manner, some experts noted that chatbots could be a burden, especially for processes that are carried out frequently, e.g., "*I wouldn't use the chatbot if it would slow me down and that, that might be the case if you do such a process three or more times a week. Then you actually know which fields you click on, then the option would be faster for me that I have an input field or a form and do not have to be led through such a dialog again [...]*". In particular, IT-affine users or 'power users' would rather rely on other systems than a chatbot. One participant stated that such users "*just want to click through the form, and that quickly, and not always have to wait for a response from the chatbot*".

Crucially, the experts were critical about the effort required to reach the desired level of quality, e.g., "*from an economic point of view, you have to think carefully about where you use it. [...] Let's take business trips, that's certainly cool to have, but I think a well-designed business trip form does this as well and you can probably run that with one developer. Whereas with a business trip chatbot, you're going to have to do a lot of work. But there are other processes, e.g., the support process at Amazon, which always starts with a chat. I don't think there's any question at all as to whether it's worth it.*" In this context, the experts also brought up continuous care and maintenance, e.g., "*[...] sooner or later, the thing dies if you don't put work in there reasonably, and the work you put in is much greater than what you need to set it up at the beginning*". Hence, one expert concluded, "*what I think is a hindrance at the moment is just the effort that chatbots take to make them good*". Thus, despite the positive effects of chatbots, the interviews revealed that especially the selection of the use case is critical and companies must be aware of the effort generated by chatbots if they intend to develop and operate them.

6.6 Discussion of the Results

$RQ_6$1: How should enterprise process-based chatbots for business processes be designed?

Based on our DSR project, we identified six design requirements and pointed out how a chatbot should be designed for executing and supporting business travel organization processes (*$RQ_6$1*). In this study, we could demonstrate that a chatbot based on our deduced design principles was, from a technical perspective, suitable for executing and thus supporting the chosen business travel organization process. Based on the generalizability of our design principles and our subsequent analysis of them, we concluded that the chatbot could also execute general business processes in digital workplaces. Therefore, we recommend that chatbots for business process applications, besides using natural language-based user interaction, should adapt the processes based on each individual user, the current dialog, or previous conversations. It seems viable to enable content-related input options to foster efficiency during the process and offer as much flexibility as possible without forcing the user to type every command or make every necessary input. Thus, the relevant processes must be mapped to enable different possibilities for each user. Besides these process-relevant requirements, we also propose that chatbots should provide direct individualized help to each user. However, as we only developed a chatbot for the case of business travel organization, the generalizability of our findings should be considered critically. As we outlined during the scenario description, we selected the process because it fulfills many of the typical characteristics of self-service processes in particular and business

processes in general, e.g., regular usage, defined amount individual steps/tasks, requiring correct inputs. Thus, we expect our results to be generalizable to similar processes in specific and process-based chatbots in general.

Notably, our results confirm the current general scientific chatbot design recommendations as outlined in the design section of this contribution (e.g., Bittner/Shoury 2019; Gnewuch et al. 2017; Tavanapour et al. 2019) and extend them with process-specific requirements. Therefore, we demonstrated that process-based chatbots are comparable to classic Q&A chatbots in terms of their user interfaces and general design aspects. However, they differ regarding their process characteristics and the implementation of step-by-step process guidance [DP_2], which must be included according to each respective process.

Thus, following our study, many results from the extant literature on chatbot design can be applied to process-based chatbots. In particular, some general design recommendations seem valid for the application of chatbots in business contexts and, in particular, business processes, e.g., those of FEINE ET AL. (2020a) or DIEDERICH ET AL. (2020). Nevertheless, each company must examine and address the peculiarities of its respective processes individually. Also, this implies that general user experience aspects may be considered regardless of the application area, e.g., humanizing the dialog (Liebrecht/van Hooijdonk 2020) and applying anthropomorphic features (Diederich et al. 2020). Overall, our study supports the general applicability of chatbots for business processes, which are common in today's workplaces. In specific, we extend the current scientific knowledge base with new insights into design principles for process-based chatbots.

$RQ_6$2: How do users assess the application of process-based chatbots for business processes?

From the users' perspective (*$RQ_6$2*), we show that many participants (~71 %) had already used chatbots on at least an occasional basis, possibly from private use. Hence, because general conversational user interfaces and chatbots, seem to have already become part of everyday life, they may be smoothly incorporated into everyday working life. The risks and necessary training efforts that come with new systems could thus be less or not required. In this study, we found that our chatbot showed a quite high usability for the given business processes. A first indicator of usability is the capability of a technology to successfully and timely conduct the evaluated processes. Therefore, if the usability of our chatbot was poor, we would not have achieved such good results. Additionally, as identified by the UEQ benchmark (Schrepp et al. 2017), we showed that our chatbot was perceived as user-friendly to a substantial degree. In particular, perspicuity and novelty received the highest ratings. The ratings for novelty differed the most between the chatbot and the current method. Because all of our derived design principles received good feedback, they were clearly relevant for the development of process-based chatbots. Ultimately, we confirmed and verified the existing design principles and requirements of the scientific community and demonstrated their applicability to process-based chatbots. Namely, process guidance and context-dependent input options are important to chatbots for business processes, as both received the highest scores. Based on our derived measurement model, our results indicate that users are willing to use chatbots for business processes. Since acceptance is rather a critical success factor for application systems, our results further support our assessment of the applicability of chatbots.

Therefore, the risk of developing a system that will not be used is rather low. Thus, we could provide first starting points and promising tendencies by a derived measurement model based on the TAM and the ISSM (Davis 1989; DeLone/McLean 2003). We observed that user satisfaction was mostly influenced by usefulness instead of ease of use. Thus, in business applications, the capability of chatbots to map and execute the given tasks or processes is rather crucial and less the appearance, as already shown by RIETZ ET AL. (2019).

However, as our DSR artifact was based on a rather outdated starting basis (the current business travel organization process), it can be argued that this automatically led to better results. Nevertheless, our study did not aim to replace the current process. Rather, it evaluated users' perspectives on a chatbot that conducts business processes. With a better baseline, the results would probably not be quite so far apart. Regardless, the result remains the same: chatbots can basically be used for business processes, and this concept is well received from the user's point of view. Lastly, we deliberately gave little consideration to the human or anthropomorphic elements frequently discussed in the literature (e.g., Diederich et al. 2020; Liebrecht/van Hooijdonk 2020) because our focus was on the applicability, usability, and resulting benefits of a chatbot for business processes. This focus was already highlighted by RIETZ ET AL. (2019) as the most important factor in a working environment, instead of anthropomorphic features. Nonetheless, our results already show good usability and levels of human behavior. Thus, our results are already a good starting point for future studies. Following the literature, even better results may be achieved with more emphasis on humanness and anthropomorphism. Thus, we could summarize our findings for *$RQ_6 2$* with three propositions:

(1) Using process-based chatbots, usability is better perceived than with classic enterprise systems.

(2) Using process-based chatbots, user acceptance is present.

(3) Using process-based chatbots leads to higher user satisfaction.

$RQ_6 3$: What is the business value of process-based chatbots for business processes from an organizational perspective?

From an organizational perspective (*$RQ_6 3$*), we demonstrated that the process cycle times of our chatbot were on an equal level compared to the current/classic enterprise systems. The cycle times were even faster with the chatbot, especially, during the second task. Therefore, we conclude that the learning effects of using chatbots are higher than those of classic systems. Extending this, we found that existing individual IT-affinity and knowledge of the evaluation process, at least in our evaluation case, only had a marginal influence. Hence, every user can conduct the given process with the chatbot regardless of his personal knowledge. This further proves the chatbots' capability to support in processes in which users have less to no experience. Similar results could be found with regard to the likelihood of failures. We observed that the chatbot reduced the danger of critical errors (e.g., process aborts or restarts) by approx. 17 % and 31 % per task compared to the current method. Thus, the tasks may have been clearer with the chatbot because the users only needed to answer questions, which reduced information overload, and could receive targeted assistance if they had any issues.

Nonetheless, we determined that the chatbot also increased the danger of false positives. These kinds of errors are difficult to identify, even in classical systems, and usually require human review. Hence, we interpret this result as a signal to adjust the prototype, e.g., conduct a second design cycle, and pay more attention to the chatbot's messages and instructions. Nonetheless, we have already verified the results of MANSEAU (2020), especially regarding the positive outcomes on efficiency and productivity. However, the results would probably not differ that much with a better baseline, e.g., different process implementation. From a business perspective, we were also able to show that chatbots are suitable for business processes and can keep up with the status quo. Thus, we could summarize our findings for *$RQ_6 3$* with three propositions:

(4) Using process-based chatbots, business processes can be executed in comparable or faster lead times to existing solutions.

(5) Using process-based chatbots, users' IT affinity or existing process knowledge has no influence on executing the corresponding process.

(6) Using process-based chatbots, the risk of critical errors or interruptions in the process is reduced.

Nevertheless, these results must be approached critically. As noted by the experts, even if chatbots achieve positive effects, these effects are countered by the effort required to create and maintain them. Companies should be aware of this and be willing to use chatbots as a means of improving work quality, even though they may not make a monetary contribution or reduce costs. Therefore, our results indicate possible effects, from both the applicability perspective in terms of process efficiency and quality and the actual users' perspectives in terms of usability and acceptance. Decision-makers must compare both perspectives with the cost of chatbot acquisition and operation to assess possible projects and make a decision that all involved or responsible parties can stand behind. The danger of "just doing it" with resulting negative effects can, thus, be avoided. In addition, as we only evaluated one point in time, the question arises as to whether the results are confirmed with recurrent use or rely on novelty effects. As mentioned by some experts, a chatbot may be a hindrance for 'power users', who feel forced into the dialog and cannot quickly carry out the process. However, based on our data, we could not identify substantial differences between the participant groups. Despite this, it seems necessary to clarify how those users can be encouraged to use chatbots, what a chatbot for them should look like, and whether a chatbot is the right system for such use cases. Regardless, chatbots may be advantageous for inexperienced users because they can carry out processes without prior knowledge. Depending on the context, perhaps future users should be given a choice regarding which system they want to use. For instance, inexperienced users get the chatbot, whereas experienced users can choose between the chatbot and traditional systems.

6.7 Summarizing the Knowledge on Designing Process-based Chatbots as a Nascent Design Theory

To conclusive document the overall design-knowledge of our *Design Science Research* project on process-based chatbots for business processes at digital workplaces, we formulate a *Nascent Design*

Theory using the core constructs according to GREGOR/JONES (2007). Consequently, in Table 41, we summarize our results based on the six components purpose and scope, constructs, principles of form and function, artifact mutability, testable propositions, and justificatory knowledge, to deduce a theory on "*Design and Action*" (Gregor/Jones 2007).

Component	Description
Purpose and scope	The purpose of the concept and evaluation of the process-based chatbot artifact is to support and execute business processes for employees at the digital workplace.
Constructs	Chatbot, finite state machine-based business process implementation, knowledge base of questions, and process overview.
Principles of form and function	Through a review of process-based chatbot literature, user stories, and process analysis, we derived six design principles that were qualitatively and quantitatively proven by the experimental evaluation study: DP_1: Natural language user interface DP_2: Process guidance including progress overview DP_3: Individualized adaptation of the process to the user DP_4: Context-dependent input options DP_5: Integrated help function via dialog DP_6: Automatic error handling
Artifact mutability	By using the deduced design principles, a business-process chatbot can be developed independently of a given process or application area. Consequently and based on a process analysis, the finite state machine has to be adapted and the knowledge base must be enriched with respective possible questions. By further integrating the chatbot with existing enterprise systems, the functionality can be further improved, e.g., for automatic data processing.
Testable propositions	To test the design principles, further process-based chatbots should be developed and evaluated. To evaluate the effects of a process-based chatbot, the following propositions, which can be derived from our results, should be considered: (1) Using process-based chatbots, usability is better received than with classic enterprise systems. (2) Using process-based chatbots, user acceptance is present and, therefore, an ongoing usage can be assumed. (3) Using process-based chatbots leads to higher user satisfaction with the system. (4) Using process-based chatbots, traditional business processes can be executed in comparable or faster lead times to existing solutions. (5) Using process-based chatbots, IT-affinity or existing knowledge on the respective process has no influence on executing the corresponding business process. (6) Using process-based chatbots, the risk of critical errors or interruptions in the process is reduced.
Justificatory knowledge	Scientific knowledge base, employee experiences with business processes and process analysis; Empirical knowledge from an evaluation with 69 participants of three groups.
Principles of implementation	We provide *Spot* as an example on how to instantiate design in the form of a process-based chatbot artifact. It can easily be configured, modified, and adapted to further business processes with the same characteristics.

Table 41 Nascent Design Theory for Process-based Chatbots at the Digital Workplace

6.8 Limitations of the Study

Despite the positive results, there exist some limitations worth mentioning. First, we surveyed a process-based chatbot application based on only one exemplary case. To obtain more generalizable results on the design of process-based chatbots, our design principles must be tested on further application scenarios by implementing corresponding artifacts. Especially, if the processes differ significantly from our analyzed process, the generalizability of the results will be hampered. However, our results indicate the general suitability of chatbots specifically for business travel organization processes and partly for general business processes. Thus, our results can be used for further process-based business chatbots. Second, we did not consider anthropomorphic aspects for the most

part, as we prioritize the chatbots' capability to execute processes (Rietz et al. 2019). Thus, future studies should survey the extent to which these elements also influence process deployments. However, our results already show a quite good usability rating, and with further consideration of anthropomorphic elements, this can theoretically be improved (Diederich et al. 2020). Third, even though we completed the DSR-cycle, our artifact was still in a prototype state, as shown in the evaluation. Hence, its functionality was limited and still had possibilities for improvements. In addition, depending on the chosen scenario, it is possible to create different artifacts based on our design principles. However, our results verify the general applicability of chatbots for business processes and present quite good values for user experience. Fourth, our evaluation results are dependent on the participants, their experience with chatbots or given business processes, as well as their willingness to participate. Therefore, we incorporated a suitable number of participants consisting of students, employees, and external experts of different ages, and IT-affinity levels, experiences with the business process, and experiences with chatbots. Additionally, to further prevent bias, we randomized the order and extent of the evaluation and the respective setting. However, as we could only acquire 69 participants, the evaluation should be expanded. Nonetheless, our results already show first indications and significant results on the general applicability and usability of chatbots for business processes. Fifth, our measurement model was only derived from the items, constructs, and relationships of the original TAM and ISSM because our study did not focus on model development. Nevertheless, our derived preliminary model can already show initial relationships and influences for chatbots, which can be used as a starting point for further research. However, the model and its relationships must be verified in a proper model development study. Sixth, as we have only measured at one point in time, it is difficult to make statements about long-term or repetitive chatbot usage. This subject was brought up by the experts. It is, therefore, necessary to carry out longitudinal studies to determine the effects depending on the duration of use.

6.9 Conclusion

In this scientific-founded *Design Science Research* study, we applied a process-based chatbot to a real business process and evaluated its impacts. We demonstrated that chatbots (1) are applicable for business processes, and (2) achieve high usability in business processes. Furthermore, we (3) provided six design principles for process-based chatbots. Thus, we contribute to both, research and practice. For the scientific community, notably, we closed the existing research gap by deducing design principles useable for future process-based chatbots, particularly for form-based processes like the used business travel organization process. Our propositions also provide starting points for future chatbot studies. For practice, we showed that chatbots could be used to successfully execute business processes. Especially for lesser error probability and better usability, the use of chatbots makes sense. Companies can use our results to evaluate possible chatbot projects to make a decision. Nonetheless, our results must be verified on a wider scale and with different business processes.

C Research Complex: Chatbot Development, Introduction, and Operation in Business

In addition to laying a scientific foundation and designing chatbots for workplace application scenarios, it is necessary to provide support for practice, that is, project lead or management. For this purpose and in addition to providing general design principles, it is necessary to make scientific results reusable in a targeted manner. Therefore, research complex C aims at supporting businesses in chatbot projects throughout the chatbots' lifecycle. Consequently, the research question of research complex C addresses the practice support with scientific findings [MRQ3]. This research question is subdivided into two sub-meta research questions [MRQ3.1-2] (see Table 3) addressed by one study.

First, research complex C examines how scientific results can be used to guide chatbot projects in practice in a targeted manner [MRQ3.1]. Second, it is surveyed how chatbot projects in specific should be conducted in a structured manner and, partly, how they differ from typical IT project approaches [MRQ3.1]. Both questions are addressed by Study VII (see Figure 44). As surveyed by the different studies of this thesis so far, many aspects are to be considered for a chatbot application in business, i.e., application areas and objectives (Study I and Study II). Additionally, as Study III revealed, many influencing factors and challenges exist that can counteract the overall project success. Furthermore, the design aspects and decisions (Study IV, Study V, and Study VI) in turn lead to further necessary steps or limit/specify certain project activities in advance. Thus, as no overarching project framework or guideline for chatbot projects exists, Study VII aims at deriving a procedure model for chatbot projects based on actionable tasks [RQ_7] (Meyer von Wolff et al. 2022a). Therefore, Study VII summarizes the previous studies and some of the scientific research on chatbots in business contexts by aligning them with the different phases of a chatbot project. In doing so and based on a two-iteration *Design Science Research* study (Hevner et al. 2004; Hevner 2007) a chatbot procedure model is described. The resulting procedure model encompasses the four phases of planning, development, test, and operation and includes up to 41 tasks.

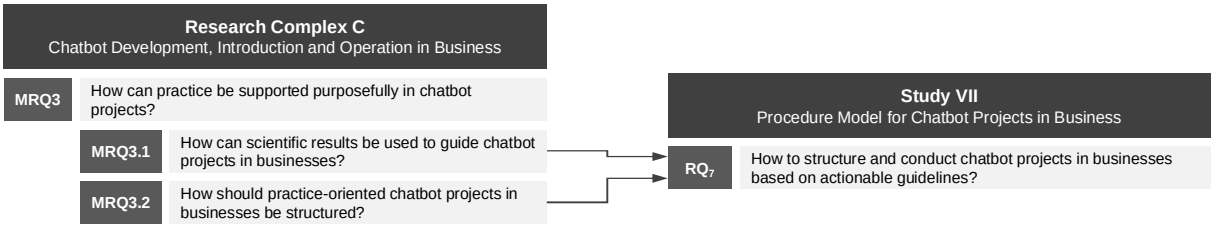


Figure 44 Overview of the Studies and their Research Questions of Research Complex C

Supplementary information for Study VII is available in Appendix A7. This encompasses the initial procedure model and the procedure model after the first iteration.

7 Procedure Model for Chatbot Projects in Business

> Chatbot Introduction and Operation in Enterprises – A Design Science Research-based Structured Procedure Model for Chatbot Projects

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Chatbot Introduction and Operation in Enterprises – A Design Science Research-based Structured Procedure Model for Chatbot Projects

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Abstract

Chatbot research has become an emerging research area. Researchers survey the technology behind and the whole ecosystem from different perspectives, e.g., human-computer interaction, design research, or anthropomorphism. To foster the transfer from research to practice, a comprehensive structured procedure model is missing yet. Due to this, the transfer of the research results into real-world settings in enterprises is often complicated. Hereto, we propose a comprehensive structured procedure model to guide practitioners in chatbot projects based on a Design Science Research study. In doing so, necessary project steps are pointed out and corresponding research results are highlighted to make them reusable for practice in a targeted manner. Thus, we provide structured support for chatbot projects in enterprises.

1. Introduction

Chatbot research is currently a widespread field of research in today's scientific community. Also from a practice perspective, the adoption of chatbots is increasing and more and more companies want to integrate chatbots into their application landscape. Due to digitalization efforts and intentions to support employees in enterprises more individually, chatbots or conversational agents are been applied in various scenarios like customer support, information acquisition, or e-learning [1–4]. Hereby, the research community adapts to this by surveying chatbots through different application areas [5–7] or by deriving design recommendations for creating chatbots [7, 8]. Besides application area-centered research, researchers try to survey the chatbot ecosystem on a more general business level. Thereby, research directions tackle, e.g., trust aspects, humanizing the chatbot, and challenges [2, 9–12]. This generalized research can typically be reused and adapted for deviating scenarios or use cases. However, for productive applications of chatbots, e.g., in enterprises, these contributions only cover single aspects of the whole project lifecycle. Depending on project progress, different aspects need to be considered. The intertwining among the scientific findings is further difficult to trace and almost impossible to map through the individual contributions. Practitioners are faced with the challenge of implementing and carrying out their own chatbot projects due to missing guidelines. But also for science, the linkage of the contributions and their mutual effects cannot be made completely transparent. Thus, there is a need for a comprehensive structured framework on how to incorporate the existing research for conducting enterprise chatbot projects.

Up to now, some researchers already summarize their findings and deduce generalized design principles for enterprise chatbots [2, 13, 14]. However, only two approaches are known to us that aim at creating enterprise guidelines [15, 16]. Hereby the first focuses only on the technical aspects while disregarding the organizational or individual ones. The second one addresses three partial aspects, i.e., use case, technology, and humanness, and derives best practices without integrating them into overall project organizations. Thus, comprehensive guidelines covering all relevant aspects of the chatbot lifecycle, i.e., technical, organizational, and individual, are missing. For applications in enterprises, the current research could often not easily be applied in a targeted manner. This can also hinder chatbot projects in businesses and result in lower outcomes, as critical aspects are forgotten, or wrong decisions are made.

Thus, our research aim is to construct a comprehensive business guideline for conducting chatbot projects. Therefore, we propose a procedure model for chatbot projects from an organizational-level, which (1) builds on previous experiences of chatbot projects, and (2) includes scientific results to guide future projects. Hereto, we conduct a Design Science Research (DSR) study [17, 18] and answer the research question:

How to structure and conduct chatbot projects in businesses based on actionable guidelines?

Next, we outline the related research. Then, we describe our DSR-approach. After this, we present our procedure model and discuss the results.

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Abstract Chatbot research has become an emerging research area. Researchers survey the technology behind and the whole ecosystem from different perspectives, e.g., human-computer interaction, design research, or anthropomorphism. To foster the transfer from research to practice, a comprehensive structured procedure model is missing yet. Due to this, the transfer of the research results into real-world settings in enterprises is often complicated. Hereto, we propose a comprehensive structured procedure model to guide practitioners in chatbot projects based on a Design Science Research study. In doing so, necessary project steps are pointed out and corresponding research results are highlighted to make them reusable for practice in a targeted manner. Thus, we provide structured support for chatbot projects in enterprises.

Keywords Chatbot, Conversational Agent, Procedure Model, Guideline, Project Management, Design Science Research.

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Up to now, some researchers have already summarized their findings and deduced generalized design principles for enterprise chatbots (Diederich et al. 2022; Feine et al. 2020a; Meyer von Wolff et al. 2020a). However, only two approaches are known to us that aim at creating enterprise guidelines (Schuetzler et al. 2021; Winkler et al. 2020b). The first focuses only on the technical aspects while disregarding the organizational or individual ones. The second one addresses three partial aspects, i.e., use case, technology, and humanness, and derives best practices without integrating them into overall project organizations. Thus, comprehensive guidelines covering all relevant aspects of the chatbot lifecycle, i.e., technical, organizational, and individual, are missing. For applications in enterprises, the current research could often not easily be applied in a targeted manner. This can also hinder chatbot projects in businesses and result in lower outcomes, as critical aspects are forgotten, or wrong decisions are made.

Thus, our research aim is to construct a comprehensive business guideline for conducting chatbot projects. Therefore, we propose a procedure model for chatbot projects from an organizational level, which (1) builds on previous experiences of chatbot projects, and (2) includes scientific results to guide future projects. For this purpose, we conduct a *Design Science Research* (DSR) study (Hevner et al. 2004; Hevner 2007) and answer the research question:

RQ_7	How to structure and conduct chatbot projects in businesses based on actionable guidelines?

Next, we outline the related research. Then, we describe our DSR-approach. After this, we present our procedure model and discuss the results.

7.2 Related Research

Due to the increasing research in the last years, various terms emerged, e.g., *chatbots* (Følstad/Brandtzæg 2017), *smart personal assistant* (Winkler et al. 2020b), *conversational agent* (Gnewuch et al. 2017), *digital assistant* (Maedche et al. 2019), or *conversational user interface* (Holmes et al. 2019). However, all describe information systems that use artificial intelligence and machine learning in terms of natural language processing to provide a dialog-based user interface. Users can communicate naturally by voice or text to obtain information or perform functions. Technically, chatbots process natural language inputs to extract patterns and identify the users' intent. Based on the intent, the chatbot decides how to respond. Besides the chatbot's knowledge base, this requires integration with databases or (enterprise) systems (Meyer von Wolff et al. 2020a).

With the use of chatbots in enterprises, e.g., for information acquisition, conducting business processes, or as a means for education, various potentials shall be achieved (Carayannopoulos 2018; Laumer et al. 2019b; Meyer von Wolff et al. 2020a). Among others, employees should be able to use systems without prior training due to their natural language interfaces (Carayannopoulos 2018; Følstad/Brandtzæg 2017); employees, especially in support areas, should be relieved through the chatbot by answering questions automatically, and, thus, processes become independent of further human resources (Gnewuch et al. 2017; Meyer von Wolff et al. 2020a). So that all in all, systems become more user-centered and the quality of work is increased.

To reach these potentials of chatbots at workplaces, a lot of design research has been done so far. Besides the major focus on customer-focused areas (e.g., Corea et al. 2020; Gnewuch et al. 2017; Johannsen et al. 2018; Liebrecht/van Hooijdonk 2020), for example, ELSHAN/EBEL (2020) survey chatbots as teammates, and WINKLER ET AL. (2019) apply them for problem-solving in businesses. Besides this, chatbots were also used as a means for feedback exchange (Lechler et al. 2019). For more process-like applications, TAVANAPOUR ET AL. (2019) support the ideation process with a chatbot. HOBERT (2019b), and partly CHAKRABARTI/LUGER (2015), equip a chatbot with a finite state machine to dynamically map processes to support complex tasks and allow longer conversations. Additionally, FEINE ET AL. (2020a), DIEDERICH ET AL. (2020), as well as RIETZ ET AL. (2019) summarize their findings by design principles for enterprise chatbots.

Since the research aim is to derive a comprehensive procedure model for practice, it is further necessary to identify meta-level research relevant on a project scale. As of now, a few studies can be found, that address this for enterprise applications of chatbots, e.g., in terms of application areas or use cases (Laumer et al. 2019b; Meyer von Wolff et al. 2020a). Also, some approaches that focus on influencing factors and challenges during a chatbot project are available (Meyer von Wolff et al. 2021b; Rodríguez

Cardona et al. 2019). Further studies bring together the existing scientific results in chatbot research in the form of literature reviews (Bavaresco et al. 2020; Diederich et al. 2022; Feng/Buxmann 2020; Lewandowski et al. 2021; Meyer von Wolff et al. 2019a; Stieglitz et al. 2018) or to create a taxonomy of chatbots (Janssen et al. 2020). However, they categorize the results with a scientific focus and often do not provide guidance for practitioners. Additionally, ADAM ET AL. (2021) show that there are three HCI research modes, and what aspects are addressed and considered in each for respective projects. A different approach highlights the knowledge needed for chatbot DSR-projects (Feine et al. 2019b). As mentioned in the introduction, WINKLER ET AL. (2020b) and SCHUETZLER ET AL. (2021) summarize scientific findings to apply them in a targeted process-oriented manner. However, only individual aspects are presented, so that usability for the entire chatbots' lifecycle is limited.

Thus, we build on previous research and create a structured guideline aligned with the lifecycle of chatbot projects. In doing so, we provide a meta-level DSR process-artifact to unite the previously achieved results to make them applicable in a targeted manner.

7.3 Research Design

To unite the scientific results in chatbot research, and expertise from previous chatbot projects to deduce a comprehensive and generalized procedure model, we conducted a *Design Science Research* project according to HEVNER ET AL. (2004) and HEVNER (2007). In doing so, we contribute with both (1) a problem-oriented process artifact, and (2) actionable guidelines to conduct chatbot projects in enterprises. In overall, we conducted three iterations consisting of ten research steps (see Figure 45).

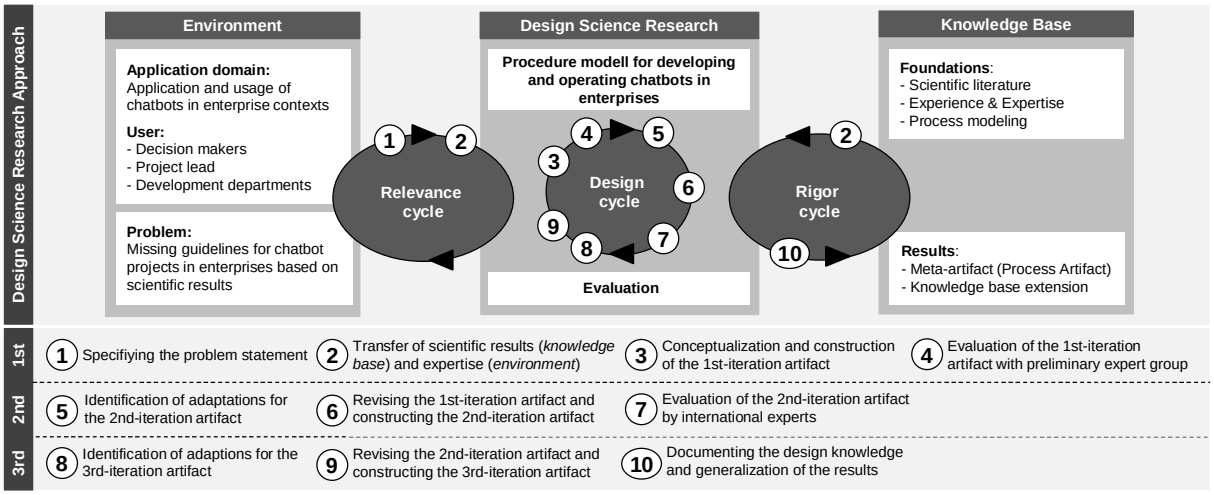

Figure 45 Applied Design Science Research Approach

7.3.1 1st-Iteration – Constructing the Artifact

In the 1st-iteration of our DSR-project, we set up the initial process artifact (see Figure 45). ① We examined the lack of missing enterprise support for structuring and carrying out chatbot projects in practice and derived the research problem. ② Subsequently, we used existing scientific results as well as our own experience and expertise in chatbot research (Hobert 2019a; Hobert 2019b; Meyer von Wolff et al. 2019a; Meyer von Wolff et al. 2020a; Meyer von Wolff et al. 2021b) as the foundation. ③ Based

on this, we deduced necessary steps and decisions to be taken in chatbot projects. Following a discussion in the research team, they were used to create the initial version of the procedure model. The initial model is logically aligned with classic software development processes, and consists of the phases planning, development, implementation, test, and operation, with a total of 21 steps (partial with sub-steps or selection options). See Appendix A7.1 for the initial artifact[26]. ④ Finishing the 1st-iteration, we evaluated the initial model. For this purpose, we conducted eight workshops with 10 local participants who conducted or guided chatbot projects on their own. The sessions lasted 66 minutes on average and were supported by an A0-print of the model. During the workshops, the model was discussed, and adjustments were recorded.

7.3.2 2nd-Iteration – Revising the Artifact

In the 2nd-iteration (see Figure 45), we ⑤ first summarized the evaluation results and derived enhancements. ⑥ Based on them, the initial model was adapted to develop our 2nd-iteration procedure model. In doing so, we extended and refined the initial procedure model by 15 steps, resulting in a 2nd-iteration procedure model consisting of 36 steps. In addition, returns and iterations are added to allow a more dynamic procedure model, and the phases were reduced to planning, development, test, and operation. See Appendix A7.2 for the 2nd-iteration procedure model[27]. ⑦ The revised procedure model was evaluated to close the 2nd-iteration. For this, we evaluated the procedure model on a broader and international scale with participants who (a) have experience in chatbot projects or develop chatbot projects, or are (b) involved in chatbot research to incorporate their scientific findings into our procedure mode. Therefore, we hosted a 2-hour workshop at last year's *CONVERSATIONS 2020* conference (CONVERSATIONS 2020). The workshop was attended by 13 international experts and researchers virtually due to the COVID19-situation. During the workshop and after initial brainstorming, each participant got access to the 2nd-iteration procedure model via a website and could make annotations virtually. Lastly, our procedure model was discussed in the plenary, and notes were taken.

7.3.3 3rd-Iteration – Finalizing the Artifact

Following, the 3rd-iteration started to develop our tentative final procedure model artifact (see Figure 45). For this purpose, ⑧ the workshop findings, i.e., brainstorming results, discussion notes, and participants' annotations, were merged to identify enhancements. ⑨ Based on them, we created our tentative final 3rd-iteration procedure model for chatbot projects (see Section 4). Consequently, the 2nd-iteration procedure model was again refined and extended by five steps. ⑩ Lastly, we documented the findings in this contribution.

[26] In the published version, reference was made to the online image available at *http://bit.ly/1st-Iter.*

[27] In the published version, reference was made to the online image available at *http://bit.ly/2nd-Iter.*

7.4 A Structured Procedure Model for Chatbot Projects in Enterprises

Next, our final procedure model for chatbot projects is described (see Figure 46-Figure 49; the entire image is also available online at: *http://bit.ly/CB_PM*). Accordingly, chatbot projects should encompass the phases: *planning*, *development*, *test,* and *operation,* which are passed through one after the other while allowing returns or iterations.

7.4.1 Planning Phase

Typically, chatbot projects begin with the planning phase. General conditions and objectives need to be defined like in any typical software-related project. Also, organizational, technical, and individual foundations and capacities are created in the firm and the overall project is set (see Figure 46; enhancements between 1st- and 3rd-iteration are highlighted by color).

According to our findings, a chatbot project should start 1 (see Figure 46) with the fundamental plan to introduce and operate chatbots in an enterprise situation. If this, was mainly driven by the customers or users, the enterprise has to survey the user's persona in order to define them appropriately 1.1. Based on this, customers or users' requirements for the chatbot solution can be deduced by analyzing them 1.2. If the initiative was started based on the enterprise or stakeholders, the company itself, targeted processes, and application areas must be analyzed 1.3. Depending on the results, a first suitability test, if a chatbot is the right solution, should be conducted 2 (Schuetzler et al. 2021). It is advisable to pursue the project only if there is a real need or if a problem can be solved by using a chatbot. Under certain circumstances, it is also advisable to use a chatbot, e.g., to emphasize the company's innovative strength or to set itself apart from competitors as an early adopter. If the chatbot is functionally unfounded or the initiative was started due to the technological hype around chatbots (Følstad/Brandtzæg 2017; Rodríguez Cardona et al. 2019), it should be considered to stop the project as early as possible. Further, 3 companies should be clear about the specific goals they actually want to pursue with the project and whether these can be met with a chatbot, e.g., those of MANSEAU (2020) and MEYER VON WOLFF ET AL. (2020a). Only if the objectives can be addressed directly, the project should be pursued further. Otherwise, the question arises whether chatbots are really the solution since the objectives can only be addressed indirectly and are not the immediate focus of chatbots. Following this, 4 the application area must be determined. Already established application areas are especially suitable for an enterprise application. As (a) many research results are already existent and (b) previous generalized design recommendations could be reused. Overviews of possible chatbot application areas can be found for example in FENG/BUXMANN (2020), LAUMER ET AL. (2019b), or MEYER VON WOLFF ET AL. (2020a). If a deviating application area is selected, an individual review is necessary, based on which the project can be followed or stopped. As chatbots are especially useful in scenarios, where many requests, repetitive questions, or high user numbers are existent, the potential usage frequency and scalability must be evaluated 5. If the conditions are given, the functional scope is to be defined. Otherwise, it should be reflected whether chatbots are really the solution for the problem/need. Depending on the selected use case, existent results as highlighted in 4 can be

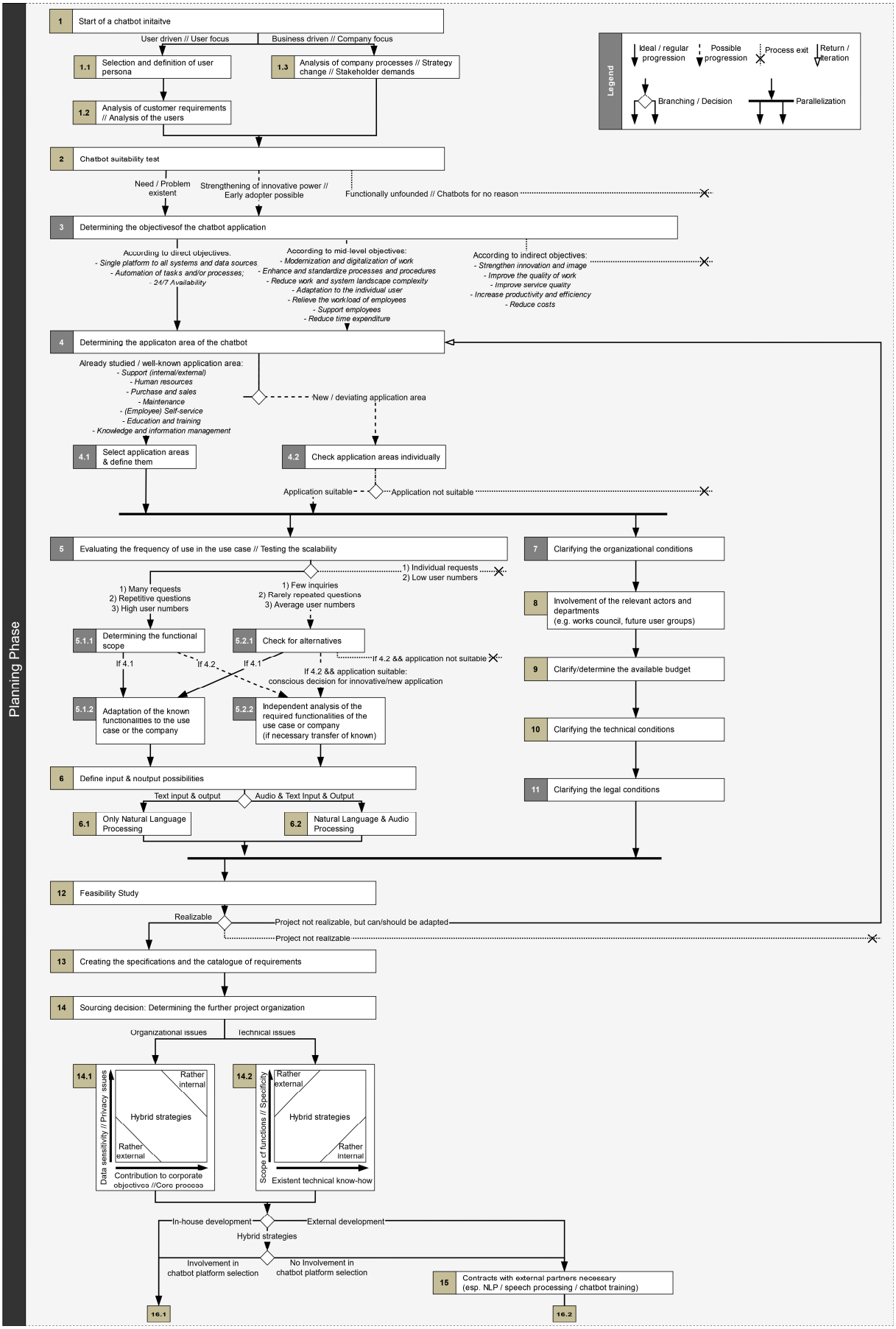

Figure 46 Planning Phase

transferred and applied, or an independent analysis is necessary. Also, [6] in- and output setting should already be determined in the planning phase since this influences the functional scope. Typically, a choice can be made between text/audio-only or audio and text in- & output (e.g., Stieglitz et al. 2018). In parallel, the organizational conditions must be clarified [7], relevant actors, e.g., works council or future users, should be involved and the project team for the further course should be created [8]. In addition, [9] the budget planning must be carried out to determine the available budget. Also, technical conditions [10], e.g., infrastructure and IT-knowhow, and legal conditions [11], e.g., data security and protection or processing of language/personal data, have to be clarified. By bringing the results of [5] to [11] together, a feasibility study can be performed [12], which marks the conscious choice for continuing the chatbot project and, thus, can be seen as a first milestone. However, if the basic decisions are not feasible, consideration can also be given to adaptation. After this feasibility study, the specifications and the requirements catalog can be derived and assembled [13]. This should be as comprehensive as possible at that point, but should also be continuously monitored and adapted during the further course of the project. The current research can provide starting points for requirements in terms of design principles (e.g., Corea et al. 2020; Diederich et al. 2020; Elshan/Ebel 2020; Feine et al. 2020a; Gnewuch et al. 2017; Johannsen et al. 2018). Next, the sourcing decision is necessary [14]. Typically, the choice is between in-house, external/outsourcing, and hybrid approaches. However for external constellations, contracts are further necessary, e.g., for data/NLP processing [15]. Based on our workshops, possible portfolios are [14.1, 14.2] (a) organizational: fit between data sensitivity/privacy and contribution to the corporate objectives/processes, and (b) technical: fit between functional scope/specificity and the existence of technical know-how in the firm. Depending on the selection, the development can start.

7.4.2 Development Phase

Following the planning, the development starts where the chatbot will be set up according to the requirements of a selected use case. In this phase, mostly technical tasks are necessary to further refine the requirements and implement the chatbot (see Figure 47; differences between 1st- and 3rd-iteration colored).

Depending on the sourcing decision, the phase starts with the selection of a chatbot platform or framework [16] (Winkler et al. 2020b). Under certain circumstances, the choice might be dependent on the external partner selected for outsourcing. As many different solutions exist, e.g., *RASA*, *Google Dialogflow*, *IBM Watson,* or *NLP.js*, some existing overviews, to begin with, can be found for example in CHATBOTS.ORG (2021), JOHANNSEN ET AL. (2018), or SCHUETZLER ET AL. (2021). Furthermore, an appropriate database architecture must be defined [17], if not determined by the platform/framework. Subsequently, the integration with existing enterprise systems must be determined [18]. If integration is wanted, the desired available enterprise systems or databases must be analyzed in terms of their interface capabilities [18.1], and the integration should be performed by using existing or newly developed interfaces [18.2]. Otherwise, also a stand-alone chatbot operation is possible [18.3]. If the desired integration is not possible, the only option is to consider a change of architecture or an

adaptation of the requirements [18.4]. Besides the integration with enterprise systems, a user interface or rather a channel integration is also necessary [19]. Therefore, the chatbot must be integrated into the desired end devices or UIs, or made be available as a new channel, e.g., for customer support. Also, the chatbots' user interface must be defined [20], e.g., control options and elements, design, colors, or overarching UI structure. In addition, our workshop participants pointed out, that in this step also the desired level of humanity and anthropomorphism must be clarified [21]. For this, enterprises can already

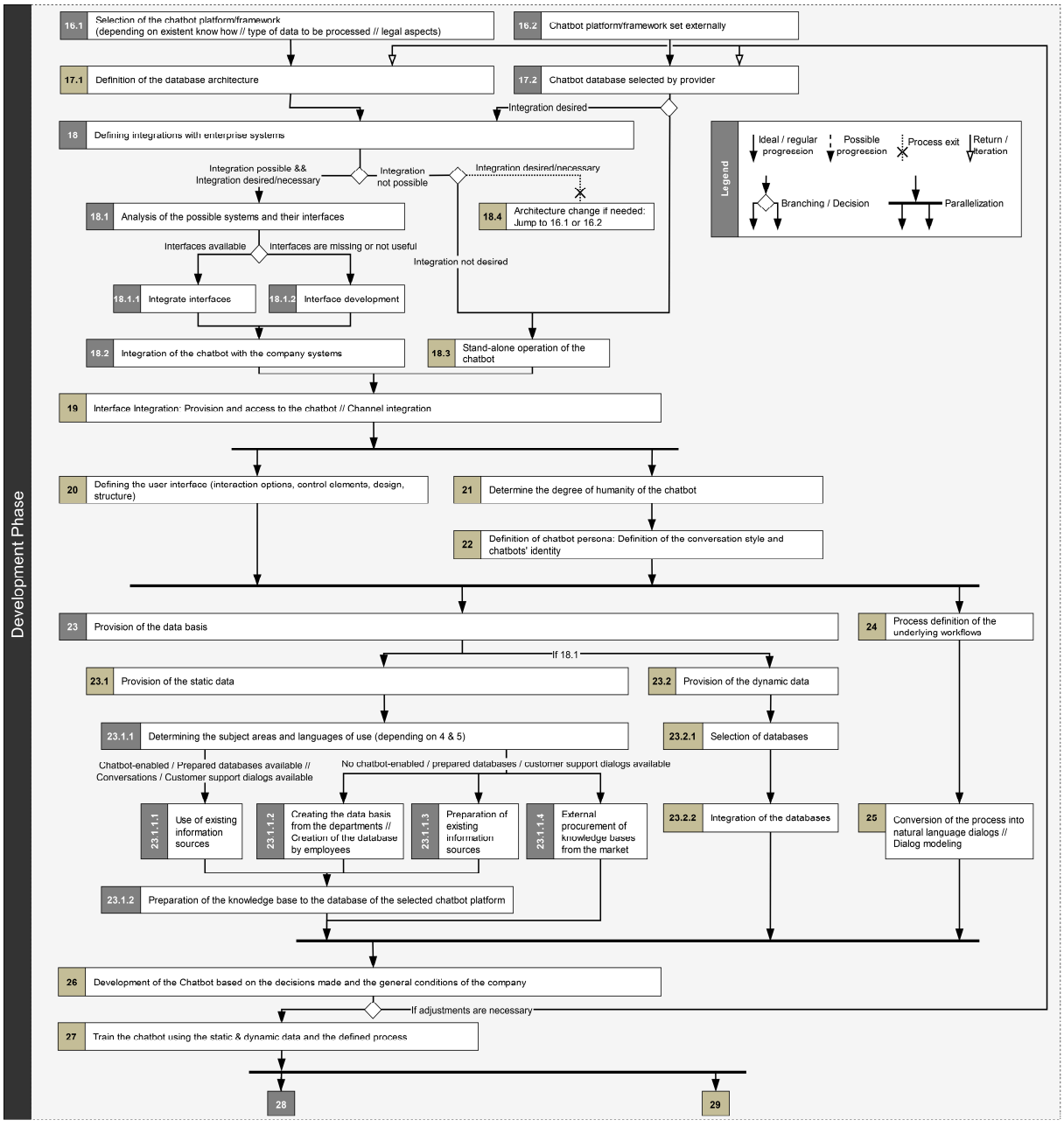

Figure 47 Development Phase

rely on a large research stream (e.g., Diederich et al. 2020; Feine et al. 2019a; Liebrecht/van Hooijdonk 2020; Rietz et al. 2019; Seeger et al. 2017). This also encompasses the definition of chatbots' persona [22] (Schuetzler et al. 2021), e.g., conversation style, appearance, or name. Following this, the critical task of providing the chatbots knowledge starts. First, the knowledge/data must be provided [23], which encompasses both the static data and the dynamic data. For the former [23.1], and taking into

account application area, functionalities, and target language, four possible options are existent according to our workshops: (1) If chatbot-capable databases or documented user dialogs are available, the existing sources should be used directly. If none of these prerequisites exist, (2) the necessary data must be created in-house, e.g., by the customer department. (3) Existing sources must be prepared in such a way that they are usable, or (4), if available, knowledge could be procured externally. For the latter 23.2, the available data sources must be selected and integrated. Second, if the chatbot should encompass or map a (business) process, the respective one must be defined 24 and transferred to natural language dialog form in terms of dialog modeling 25 (Winkler et al. 2020b). Finally, the chatbot can be developed depending on the expertise and desired development approach of the respective company, e.g., using SCRUM 26. Also, the initial chatbot training using the defined and provided static and dynamic data as well as the targeted (business) process happens 27.

7.4.3 Test Phase

Next, testing begins where the chatbot is reviewed from the users' and technical perspectives (see Figure 48; enhancements between 1st- and 3rd-iteration are colored).

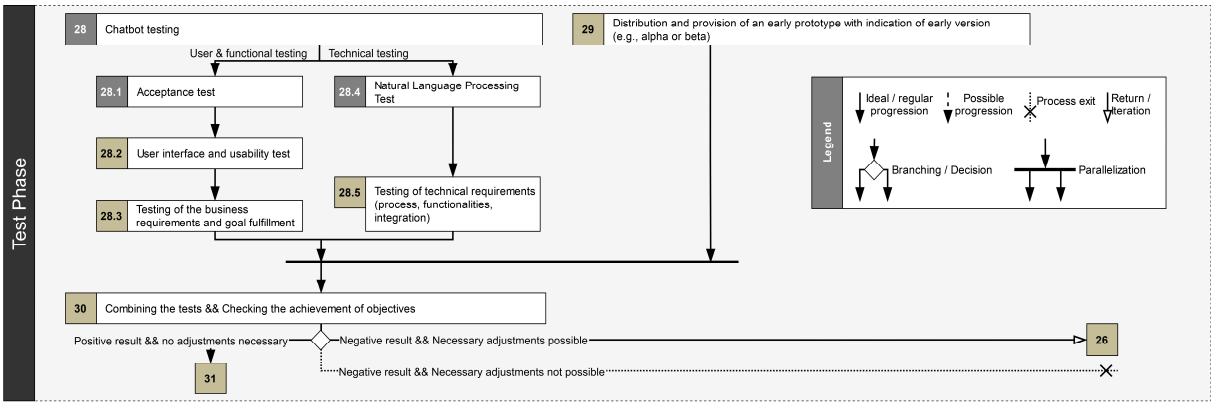

Figure 48 Test Phase

The chatbot testing 28 encompasses both user and functional tests, as well as technical tests (Winkler et al. 2020b). For the former, the acceptance for the system among future users should be determined 28.1. In addition, the user interface and the resulting users' experience should be subjected to testing 28.2. Concerning this, previous studies already applied common metrics, like the *User Experience Questionnaire*, *Chatbot Usability Questionnaire*, or the *System Usability Scale*, like in HOLMES ET AL. (2019) or MEYER VON WOLFF ET AL. (2020d). Some reviews for possible chatbot evaluations are already existent (Hobert 2019a; Maroengsit et al. 2019). Also, the fulfillment of the objectives and business requirements must be checked 28.3. From a technical perspective, the natural language processing capabilities 28.4 and the technical requirements 28.5 must be assessed to identify adjustments. In addition, it was emphasized during the workshops that access to the chatbot should be made available as early as possible for selected user groups so that their feedback can be considered as soon as possible 29. An indication notice about the current state of development is hereby necessary, e.g., alpha or beta version. By bringing the test and assessment results together 30,

it can be checked if the current instantiation complies with the specifications and can be released for productive operation. Depending on the results, the next phase starts or the chatbot must be revised.

7.4.4 Operation Phase

After testing, the chatbot operation begins. Therefore, organizational measures must be taken to successfully operate the chatbot, and continuous technical adaption is necessary to ensure error-free operation (see Figure 49; enhancements between 1st- and 3rd-iteration are colored).

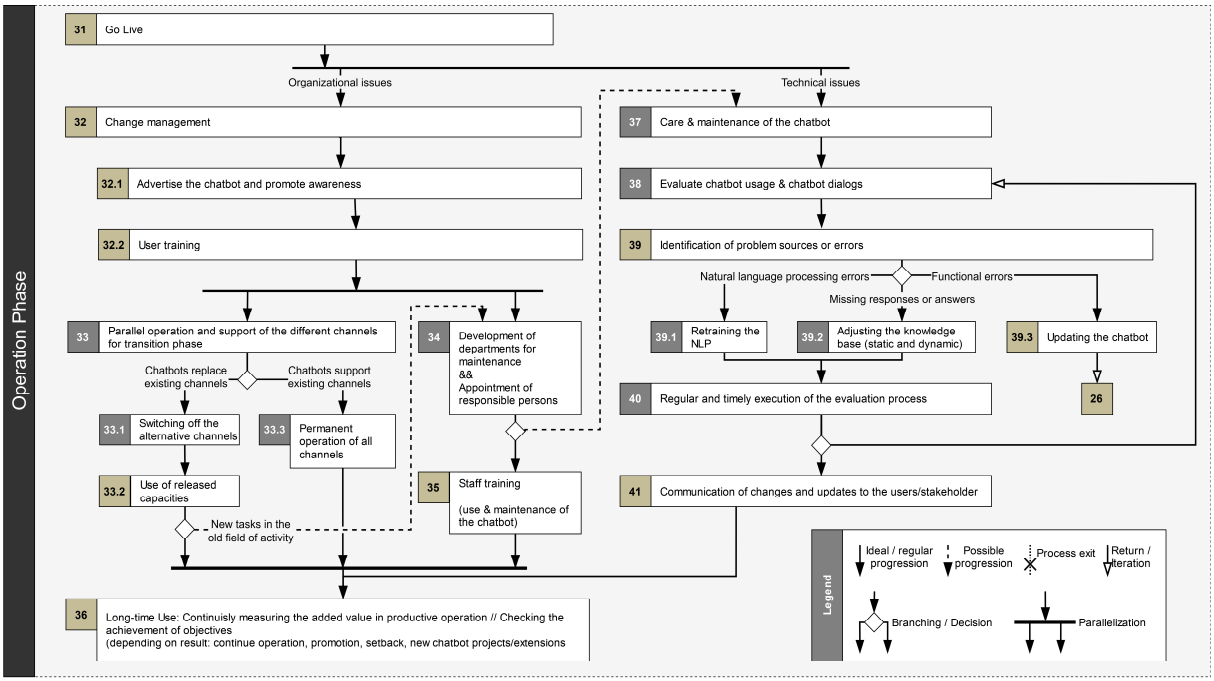

Figure 49 Operation Phase

After the "*Go Live*" 31, on the one hand, organizational issues must be taken into account. Especially, change management is necessary 32 to promote awareness for the new system, and to demonstrate and show the added value generated by the new chatbot system. In addition, training should be offered to future users to get to know the system and how to use it. This can also be done by HowTo's or help pages in the system. Further, the existing channels and the chatbot's capabilities should be compared. At least, during the transition, they should be maintained in parallel 33. If the chatbot replaces existing channels, enterprises should consider switching off the alternative channels 33.1 to free up resources that can be used elsewhere 33.2. Otherwise, permanent operation of the chatbot and the other channels seems the only viable option 33.3. In addition, enterprises must build up organizational structures for chatbots' maintenance, while also appointing someone who is responsible 34. The responsible team should also go through training for chatbot care and maintenance. From the technical perspective, it is necessary to continuously care and maintain the chatbot 37 (Winkler et al. 2020b). Accordingly, the chatbot usage and the chatbot dialogs have to be evaluated regularly 38. Based on these evaluations, which can also include aspects from the test phase, existing problem sources or errors are to be identified 39. According to them, it could be necessary to (a) retrain the NLP algorithm for a better speech understanding, (b) adjust the knowledge base or the underlying process, so that the

chatbot learns the missing answers or perform activities, or (c) update the chatbot from a technical perspective to fix bugs and errors. Regardless of the case, this entire process, starting at 38, must be carried out regularly and, above all, promptly 40. Otherwise, there is a risk that users will quickly stop using the chatbot because it does not help them, or functionalities are not carried out, e.g., due to a lack of natural language understanding. In addition, adjustments and updates made should be communicated with the users to make improvements visible 41. For the last step, our workshop participants noted that the chatbot operation must be measured and evaluated from a long-term perspective 36. In doing so, the real added value can be identified and the achievement of the initial objectives 1-3 can be measured. Depending on this, continuous operation is possible. However, also further promotion of the chatbot could be necessary, as well as setbacks or necessary adoptions up to a stop of the project. Nonetheless, also new chatbot projects can be identified as well as possible extensions to the current.

7.5 Discussion and Conclusion

Based on a *Design Science Research* approach (Hevner et al. 2004; Hevner 2007), we surveyed the applicability of scientific results and developed a comprehensive structured procedure model as a guideline for chatbot projects in enterprises.

First, we show that for many individual tasks regarding chatbot projects existing research can be applied. However, this research mostly addresses design research and corresponding requirements, their evaluations, as well as studies for anthropomorphism. To make those research results applicable in practice, practice-focused approaches are needed. Especially, chatbot project-related research is missing, e.g., project organization, sourcing, or operation. Nonetheless, comprehensive reviews are existent on which one can build as a starting point (e.g., Bavaresco et al. 2020; Diederich et al. 2022; Feng/Buxmann 2020; Lewandowski et al. 2021; Meyer von Wolff et al. 2019a).

Secondly, we show that chatbot projects should be aligned alongside the four phases *planning*, *developing*, *testing,* and *operating* while performing up to 41 tasks (see Figure 46-Figure 49). To allow flexibility and dynamic also some iterations or step-backs are necessary, e.g., if adjustments must be made. By evaluating the procedure model twice, the findings could be verified. We could show that the prior process-oriented research approaches (Schuetzler et al. 2021; Winkler et al. 2020b), cover important aspects within projects, but we could incorporate them into a comprehensive procedure model that now maps the entire chatbots' lifecycle. However, we propose a sequential order, due to better readability and simplification of the presentation in this contribution. Nevertheless, this does not mean that the order is rigid. Rather, it is also possible to deviate from the sequence or to have several tasks in parallel, than shown by us. In doing so, each willing company can use and adapt the model depending on its own characteristics and resources. However, it is important that at the end of a phase all steps of the phase have been completed and that a result has been determined for each of them. Otherwise, steps might be forgotten or decisions are made that cannot be reversed later. In this project, we deliberately did not define the actual development. This makes the resulting procedure model independent of future technological improvements. Furthermore, depending on the enterprise or the

development experience, for example, SCRUM or other forms of development procedures may be conceivable here. Hence, typical software development procedures can be applied and the respective enterprise can choose where they themselves have the most knowledge. Necessary training or learning of new procedures can be avoided. Nevertheless, critical concerns can be raised about the necessity of a specific procedure model for developing enterprise chatbots. We argue that chatbots differ substantially from classic systems, especially through the use of AI and NLP. There are new steps that do not have to be taken into account in classic IT-systems, e.g., continuous training or knowledge provision. Especially, here a linkage of existing research seems essential, as chatbots are still an emerging technology. Therefore, our procedure model is a design contribution in terms of a process artifact on how to transfer established chatbot knowledge into a company for practical usage.

Despite our results, there exist some limitations to be noted. First, our results rely mostly on scientific research and our own chatbot project experience. However, as we evaluated and enhanced our model twice, we expect it to be of high accuracy. In particular, the number of changes decreased between the iterations. Second, as the study mainly involved researchers, it is possible that practice-related aspects were overlooked or given less consideration. Thus, to measure the actual practicality, our proposed procedure model should be used for actual enterprise chatbot projects as a guideline. Consequently, a case study can be conducted to generalize our findings.

In conclusion, we contribute to both practice and research. Chatbot project managers can utilize the results to plan chatbot projects and ensure that no steps are forgotten and important decisions are made. The project can be easier communicated to stakeholders, management, or inside the team/department. Also, as we align corresponding research, they are easier to apply and the existing research can be considered in a targeted manner. Chabot programmers gain insight into design recommendations and configurations and can actively incorporate them into their developments. They can also more easily plan and finalize their development steps. For chatbot researchers, we could provide a basis for future chatbot studies and show an approach to make chatbot-related research usable. Further, we highlight topics that are relevant for enterprise chatbot research.

7.6 Acknowledgement

We thank the organizers of CONVERSATIONS 2020 (CONVERSATIONS 2020) for the opportunity to host a workshop and the workshop participants for their helpful feedback.

4 Conclusion

In this last chapter, the results of the cumulative thesis concerning the overarching research aim are summarized and critically discussed (see Figure 50).

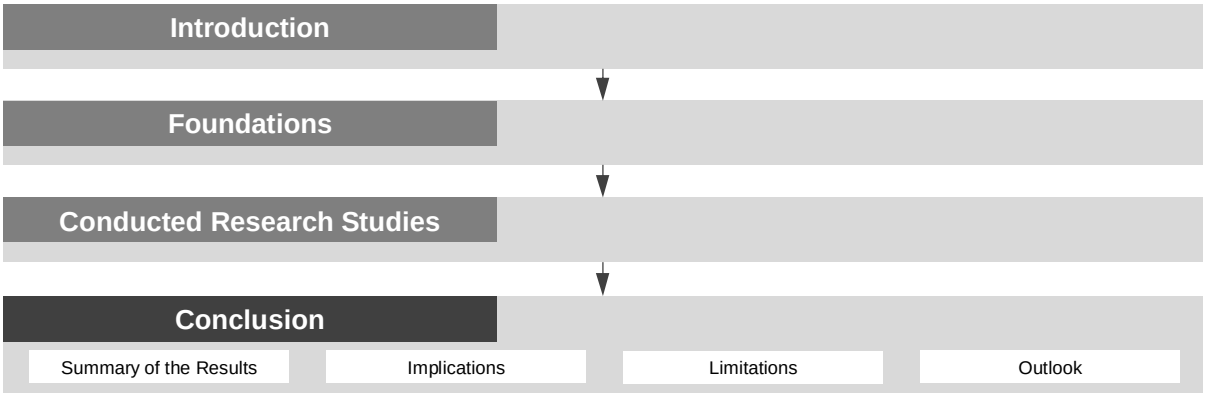

Figure 50 Structure of Chapter 4

In Section 4.1, the results of the overall thesis are presented by answering the derived three meta research questions as described in the introduction (see Section 1.2). In addition, the results are briefly outlined in the form of central findings that were derived from the conducted studies concerning the three research complexes.

Section 4.2 summarizes the implications of the thesis as derivable from the results of the research questions. In doing so, it is shown how science and practice can build upon the results.

In Section 4.3, the limitations of the thesis based on the seven conducted research studies are described, and respective required research approaches are briefly outlined.

Lastly, in Section 4.4, an outlook on possible future studies is given, as well as starting points for further research based on the results of this thesis.

4.1 Summary of the Results

The thesis contributes to the research on the application and utilization of chatbots at digital workplaces in a business context with a holistically and scientifically-founded basis comprised of scientific research, practice perspective, design-oriented studies, and a procedure model to guide chatbot projects. In doing so, the methodological pluralism of business informatics is used. The results follow the information system science perspective and are presented with high practical relevance for utilization in a corporate context. Thus, the intended contributions to science and practice were achieved (see Table 4).

In the following, the findings of the thesis are outlined. For this purpose, the meta research questions (see Section 1.2) are answered based on the seven conducted research studies of Section 3. Section 4.1 is arranged on the three research complexes, and the corresponding research questions are answered. Therefore, Section 4.1.1 discusses the findings of research complex A, Section 4.1.2 discusses the results of research complex B, and Section 4.1.3 discusses the results of research complex C.

4.1.1 How Do Science and Practice Contribute to the Application of Chatbots at the Digital Workplace?

Research complex A dealt with the state of the art and practice of chatbot application at the digital workplace. In doing so, a solid and well-established fundamental basis for further studies of the overarching research project was created by three research studies. First, a comprehensive literature review of the scientific knowledge base on chatbot research according to COOPER (1988), FETTKE (2006), and WEBSTER/WATSON (2002) was conducted to survey the state of the art (Study I) (Meyer von Wolff et al. 2019a). Second, an explorative cross-section interview study with domain experts was carried out according to DÖRING/BORTZ (2016), MYERS (2013), and WIESCHE ET AL. (2017) to get in-depth insights from the actual practice perspective from businesses (Study II and Study III) (Meyer von Wolff et al. 2020a; Meyer von Wolff et al. 2021b).

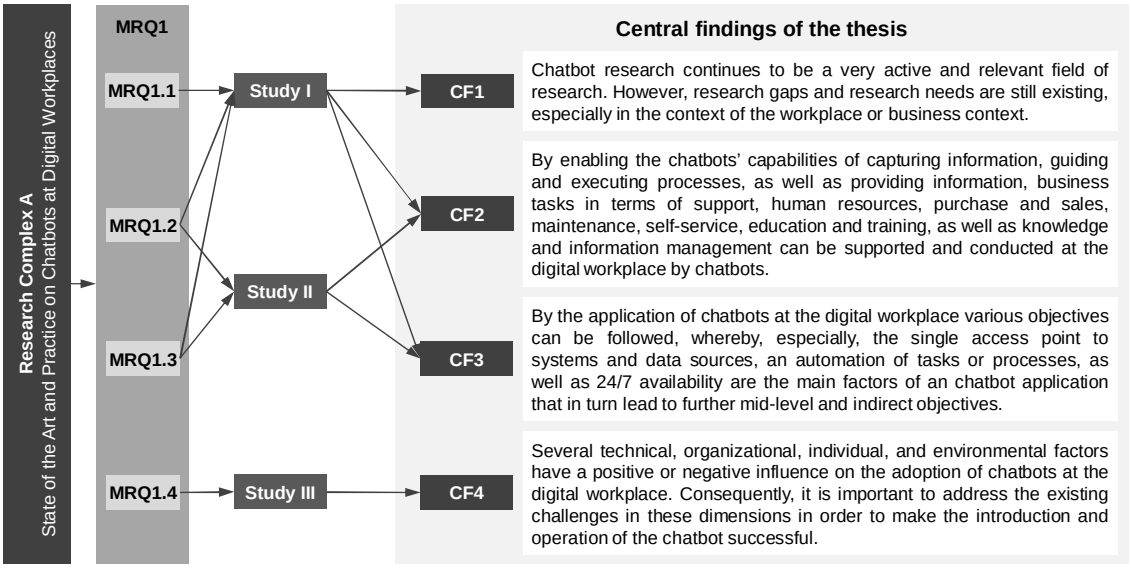

Figure 51 Central Findings of Research Complex A

In doing so, the three studies address the meta research question of how science and practice can contribute to the application of chatbots at digital workplaces [MRQ1]. This was refined by four sub-meta research questions to be able to address the individual sub-areas (see Table 1). The three studies reveal four central findings (CF*i*) for research complex A that are described in the following along with the four sub-meta research questions (see Figure 51).

MRQ1.1 What is the state of the art on chatbots for digital workplaces?

The first question addresses the current state of the art [MRQ1.1], which is mainly answered by Study I (Meyer von Wolff et al. 2019a) (see Section 3A1). However, the related research sections of the other research studies (see Section 3) also indirectly contribute to the question. Basically, the state of the art can be divided into application area-oriented and user-focused research. It was shown that in terms of application areas five domains are topics of research (see Table 11). In particular, *customer support with chatbots* at the digital workplace and *information acquisition tasks* have been extensively researched (Meyer von Wolff et al. 2019a). Little to no research exists on *self-service*, *education and training*, and *collaborative work*. The results reveal that chatbot research primarily focuses on the customer perspective or the customer touchpoints. The internal activities at the digital workplace, which is the actual focus of the thesis, are described only slightly and rather indirectly. Consequently, typical work tasks or business processes that go beyond simple question answering and information acquisition have virtually not been investigated, even though researchers mention the possibility of chatbots in these areas. This is one of the significant research gaps in the current research base and one starting point for the further studies of the thesis. In addition, in terms of the design contributions of the application area-oriented research (see Table 12), it was found that concepts and prototypes already exist, some of which have corresponding evaluations. However, on the downside, less to no research has established design requirements or design principles at the time of the review (Meyer von Wolff et al. 2019a). Also, in terms of self-service and collaborative work, which are typical workplace tasks, no design contributions were identified, indicating a further research gap. Additionally, the related research section of the newer research studies conducted, especially Study II (Meyer von Wolff et al. 2020a) and Study VI (Meyer von Wolff et al. Forthcoming), pointed out contributions to research question MRQ1.1. It was shown that in addition to the research on application areas, the humanness and anthropomorphic design of chatbots, as well as trust and other user-related research are other important research topics in the scientific community. Furthermore, some research overviews in terms of literature reviews and generalizations of findings, e.g., design recommendations or use cases, exist. Overall, as shown in MEYER VON WOLFF ET AL. (2019a) and somewhat in the other six conducted research studies, the research domain for chatbots is still growing, and many research contributions have been published so far. Consequently, a large research base exists, and the results are viable for reuse in future chatbot research in the business workplace domain. However, they often need to be transferred to the respective research aim. Nonetheless, especially for the application at digital workplaces and for workplace tasks, research gaps still exist. Therefore, open research questions were formulated targeting both behavioral and design science (see Table 13), e.g., application areas, supporting or inhibiting factors, design principles for business chatbots, and the benefits of chatbots (Meyer von Wolff et al. 2019a). As a result, these questions influenced and guided the other conducted research studies.

MRQ1.2 Which application areas are viable for chatbots at digital workplaces?

Furthermore, the second subject area examined viable application areas for chatbots at digital workplaces [MRQ1.2]. Based on both MEYER VON WOLFF ET AL. (2019a) (Study I) and MEYER VON WOLFF ET AL. (2020a) (Study II), three usages and seven application areas were identified. The studies revealed that chatbots provide the usages of *information capture* [U_1] and *provision* [U_3, P1], as well as *execution of processes* [U_2, P2] (see Table 11, and Table 18-Table 20). Particularly, *information provision or search of information* with chatbots [U_3, P1] turned out to be the most relevant role for chatbots at digital workplaces. In doing so, users ask the chatbot about information needs, and the chatbot delivers the information. Research on this already exists, as shown in MRQ1.1. Additionally, *conducting processes with chatbots* [U_2, P2] was identified in the literature and mentioned by the experts. However, in contrast to information acquisition, this task remains rather theoretical as only a few contributions address this topic, and it was mostly mentioned in the interviews. Accordingly, this was the main driver for Study VI (Meyer von Wolff et al. Forthcoming). In addition to the usages, seven application areas were identified in the two studies that can be categorized as divisional, i.e., *support* [A_1], *human resources* [A_2], *purchase and sales* [A_3], *maintenance* [A_4], and cross-divisional, i.e., *self-service* [A_5], *education and training* [A_6], and *knowledge and information management* [A_7] (see Table 21-Table 22). *Internal or external support* [A_1] and *(employee) self-service* [A_5] in particular seem to be the most relevant application scenarios at digital workplaces according to the respective mentions. Nonetheless, all application areas could be relevant depending on the respective aims of a company. The results also indicate that in the case of *support* [A_1], almost only *information provision* [U_3] is necessary, whereas in *self-service* [A_5] all determined chatbot tasks [U_{1-3}] are relevant (see Table 21-Table 22). Based on this knowledge, in Study IV, Study V, and Study VI the application scenarios information acquisition (Meyer von Wolff et al. 2020b), IT-support (Meyer von Wolff et al. 2020d), and self-service (Meyer von Wolff et al. Forthcoming) were verified as viable for chatbots at digital workplaces. To sum up, seven possible application areas were identified on which research and practice can build when planning to develop a chatbot. However, only for information acquisition tasks, especially for the support area, research is available, resulting in the research relevance of business tasks and processes, for example, in self-service or training scenarios.

MRQ1.3 Which objectives are associated with a chatbot application at digital workplaces?

Furthermore, the objectives of chatbot applications were surveyed [MRQ1.3]. Grounding on Study I (Meyer von Wolff et al. 2019a) and Study II (Meyer von Wolff et al. 2020a), several objectives were determined. Based on the literature review (Study I), six objectives [O1-O6] (see Table 11) were identified (see Section 3A1.4.4) that were extended and refined by Study II to a total of 15 objectives concerning chatbot initiatives (see Table 23-Table 25) (see Section 3A2.4.4). Additionally, the relationships among the objectives were derived to show interdependencies and benefit chains. In doing so, the objectives were further divided into direct objectives, mid-level objectives, and indirect objectives, depending on how they were influenced/addressed by the chatbot (see Figure 17) (Meyer von Wolff et al. 2020a). Aspects such as *single point of access to (enterprise) systems or databases* [O_1], the *automation of tasks or processes* [O_2], and *24/7 availability of services* [O_3] are the direct reasons for

chatbot projects (see Section 3A2.4.4). Objectives such as *reducing time expenditure* [O_{10}], *relieve of workload for employees* [O_8], and the *modernization of work* [O_4] tend to represent mid-level impacts and cannot be addressed directly. At the indirect level of objectives, topics such as *reduction of costs* [O_{15}], *increase of productivity* [O_{14}], and *improvement of work quality* [O_{12}] were identified. Notably, many of the actual drivers of chatbot projects as stated in the introduction (see Section 1.1, and the introduction sections of the conducted research studies) can be addressed but often only as a consequence of other objectives. Thus, the success of the entire chatbot project is almost always dependent on the interplay between all objectives. In terms of the mention frequencies and despite the influence level, *reduction of time expenditure* [O_{10}], *reduction of costs* [O_{15}], *relief of workload* [O_8], *single access point to resources* [O_1], and *automation* [O_2] are the main objectives for chatbot applications at the digital workplace (see Table 23-Table 25). Overall, a comprehensive overview of objectives could be derived from the state of the art and practice that could be used to clarify whether targeted objectives are possible or to show what influences a chatbot application can have at the digital workplace.

MRQ1.4 Which constraints exist for the application of chatbots at digital workplaces?

The last aspect of the state of the art and practice targets the constraints and influencing factors of the application of chatbots at the digital workplace [MRQ1.4]. Therefore, in Study III the influencing factors and challenges of a chatbot application were surveyed (Meyer von Wolff et al. 2021b). The *Technology-Organizational-Individual-Environmental* framework (Awa et al. 2017; Rosli et al. 2012), an adaption of the well-known *Technology-Organization-Environmental* framework (DePietro et al. 1990), was used for categorization to point out the influencing categories. A total of 11 influencing factors according to the four framework dimensions and respective 36 challenges that have to be addressed during chatbot projects were identified (see Section 3A3.4) (Meyer von Wolff et al. 2021b). In terms of influencing factors, the *employees* [F_I1], the *law situation* [F_E2], the *introduction of chatbots* [F_O1], and the *functional scope* [F_T2] mainly influence the application of chatbots at the digital workplace (see Figure 20). However, as identified by the mentions, the organizational influencing factors in particular have a great impact, followed by the individual ones (see Table 32). In terms of challenges, a slightly different result was achieved. *Ensuring data protection* [$C_E2.1$], *acceptance problems* [$C_I1.2$], *extensive maintenance efforts* [$C_O2.1$], and *missing benefits* [$C_O1.2$] are the most mentioned challenges that should be addressed (see Table 28-Table 31). From the perspective of the dimensions, the environmental challenges are critically followed by the individual ones, as determined by the mentions (see Table 32). To sum up, several challenges and influencing factors were identified, on which future studies can build and which practitioners should consider during the project duration. Additionally, it is notable that many classic IT influencing factors or challenges also apply to chatbots at digital workplaces, such as data protection, acceptance problems, and maintenance effort. Furthermore, our results indicate that organizational and environmental factors in particular influence chatbot applications, and environmental and individual challenges are critical for chatbots at digital workplaces. Consequently, it was shown that despite chatbots being a (new) technology, mostly the non-technical aspects influence the chatbot adoption in businesses.

4.1.2 How Should Chatbots in the Business Context be Designed?

The second research complex B addresses the design of chatbot applications for the digital workplace. Based on three studies, a design-oriented foundation was built by taking into account the requirements for chatbots, their implementation, and evaluation of potential impacts. First, a quantitative questionnaire study on requirements for information acquisition chatbots was conducted (Study IV) (Meyer von Wolff et al. 2020b). Second, a case study on the users' perspective of IT-support chatbots was carried out by giving users access to a respective chatbot and evaluating their opinion (Study V) (Meyer von Wolff et al. 2020d). Third, to examine the application for business processes, a *Design Science Research* study according to HEVNER ET AL. (2004), HEVNER (2007), and GREGOR/HEVNER (2013) was performed to design and evaluate a process-based chatbot (Study VI) (Meyer von Wolff et al. Forthcoming).

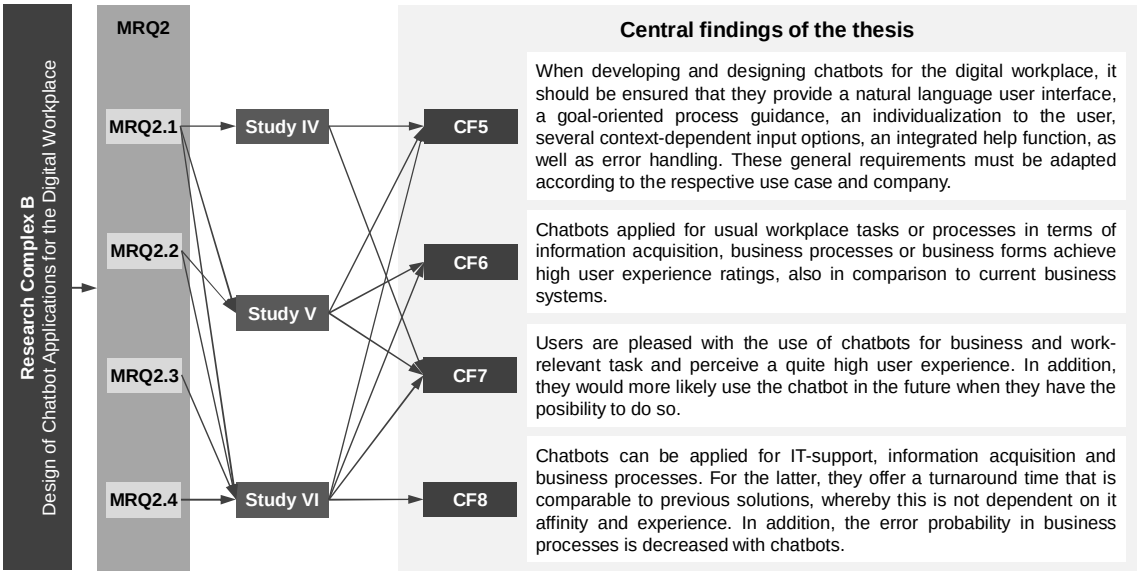

Figure 52 Central Findings of Research Complex B

The studies address the meta research question on how chatbots in the business context should be designed [MRQ2]. They also answer the four refined sub-meta research questions of research complex B (see Table 2) and provide four central findings that are outlined in the following according to the sub-meta research questions (see Figure 52).

MRQ2.1 Which design requirements exist for chatbots at digital workplaces?

To provide insights into how to design business chatbots, three studies examined the necessary design requirements for the digital workplace [MRQ2.1]. First, Study IV pointed out requirements for information acquisition chatbots (see Section 3B4.4) (Meyer von Wolff et al. 2020b), which was an identified research gap according to the state of the art [MRQ1.1]. It was shown that chatbots should provide fast answers and solutions to questions, and should be available 24/7 independent of human resources (see Figure 24). Platform independence was also demonstrated as relevant for workplace chatbots, as many potential platforms from which the chatbot should be useable are mentioned (see Figure 25). Last, by surveying potential topics and questions (see Figure 26), two further conclusions were derived. User surveys are viable for creating a chatbot knowledge base, and, more important, users have high expectations regarding the scope of a chatbots' knowledge or expect chatbots to be able to answer

many different questions. Therefore, the knowledge base is critical for the design and should be as focused as possible concerning the use case to reduce content problems. At the same time, however, the knowledge base should be as comprehensive as possible to cover almost all the questions and demands of the respective use case. Second, in Study V it was shown that for the design of chatbots, visualization and control elements in terms of pictures, text formatting, or buttons seem viable (see Section 3B5.6) (Meyer von Wolff et al. 2020d). In particular, the more visualization was used the better the chatbot was perceived (see Figure 31). Additionally, the chatbot was developed using a finite state machine, demonstrating the capability of this form of functional implementation. The chatbot can adapt itself to the user and their inputs, allowing a more dynamic procedure. Last, the relevance of the language understanding was emphasized for useable chatbot instantiations, and significant attention should be paid to this. Third, to comprehensively answer the sub-meta research question, in Study VI process-based chatbots for digital workplaces were surveyed by bringing previous results together and deriving design principles (Meyer von Wolff et al. Forthcoming). Therefore, based on user stories, a process analysis, and the current knowledge on designing chatbots, 22 requirements for process-based chatbots were derived (see Table 36). The requirements were transferred into six generalizable design principles formalized according to GREGOR ET AL. (2020) (see Table 37). Accordingly, process-based chatbots should encompass a *natural language user interface* [DP_1], *process guidance* [DP_2], *individualized adaptation* [DP_3], *context-dependent input options* [DP_4], an *integrated help-function* [DP_5], and *automated error checking* [DP_6] (see Section 3B6.4). The design principles were confirmed as viable in the evaluation as well (see Figure 41). As the requirements and therefore the design principles were also partly based on general (business) chatbots, e.g., for information acquisition or learning, the derived design principles could also be considered when developing only information acquisition chatbots for digital workplaces. In this case, more attention should be paid to the user interface, the input options, and the help function instead of the process guidance and the adaptation. To sum up, the derived design principles cannot only be used for process-based chatbots but rather for business chatbots in general. Consequently, the design principles of Study VI provide a solid starting base for developing business chatbots in general and for process-based chatbots in specific and summarize the design recommendations of research complex B concerning MRQ2.1.

MRQ2.2 How do users assess the application of chatbots at digital workplaces?

As the users' perspective is critical for the successful adoption and continuous use of a chatbot, this subject was surveyed by the second sub-meta research question of research complex B [MRQ2.2]. In particular, Study V and Study VI contributed to the research question (Meyer von Wolff et al. Forthcoming; Meyer von Wolff et al. 2020d). Study V shows that users are quite satisfied with IT-support chatbots and were able to complete the given tasks (see Figure 31) (see Section 3B5.6) (Meyer von Wolff et al. 2020d). Additionally, the users rated the chatbot better the more visualization elements were used, depending on the three evaluation cases. From the overall user experience perspective (see Figure 32), the participants rated the chatbot for the IT-support task quite good, based on the *User Experience Questionnaire* (Laugwitz et al. 2008). The same result was achieved for process-based chatbots at the digital workplace in Study VI (Meyer von Wolff et al. Forthcoming). In this study, the overall user experience of the chatbot was also rated quite high (see Figure 40) (see Section 3B6.5.3).

Interestingly, in both Study V and Study VI the user experience ratings for perspicuity and efficiency were rated best among the measured constructs. This indicates that both information acquisition and self-service chatbots are easy to learn and to understand for the users and enable the information acquisition or the execution of processes without unnecessary effort. Consequently, the results confirm that users agree with the basic idea of chatbots; instead of searching for information themselves, chatbots can provide a single answer or guide users through a process while offering good usability. Study IV partly confirmed this user expectation and more interestingly showed that users rate the usefulness higher the more often they have used chatbots (see Figure 27) (see Section 3B4.4.4) (Meyer von Wolff et al. 2020b), which also indicates a positive assessment of the chatbot idea from the users' perspective. To sum up, all the studies revealed that users are quite pleased with the user experience of chatbots for typical workplace tasks, such as information acquisition or business processes. Furthermore, Study V implicitly measured users' satisfaction and thus possible future usage. Notably, the users would tend to use the chatbot again in the future when they need IT-support (see Section 3B5.6.1) (Meyer von Wolff et al. 2020d). Accordingly, the users seem to be largely satisfied with the experience and liked the chatbot system. In contrast to Study V, Study VI explicitly considered users' acceptance of chatbots. The previous findings were confirmed (see Section 3B6.5.3) (Meyer von Wolff et al. Forthcoming). Based on the *Technology Acceptance Model* (Davis 1993) and the *Information System Success Model* (DeLone/McLean 2003) it was shown that users rate information quality, service quality, perceived usefulness, perceived ease of use, behavioral intention to use, and user satisfaction quite high (see Figure 42). Thus, the results confirm the assumption that there is general acceptance of chatbots. The results also confirm that future usage by employees can be assumed. Additionally, based on a derivable measurement model it was shown that usefulness has a greater impact on usage than user experience (see Figure 42). Consequently, attention should be paid to the particular business task to be executed and its implementation. To sum up, the conducted studies demonstrated there is user acceptance and that users are willing to use chatbots in their daily work if such systems are available. Therefore, the risk of developing a system that will not be used is rather low. Accordingly, it was shown that chatbots' usability is better perceived than that of classic enterprise systems, that there is user acceptance of chatbots, and that using chatbots leads to high user satisfaction (see Section 3B6.6) (Meyer von Wolff et al. Forthcoming). However, on the downside, in the experts' interviews in Study VI, there was criticism regarding power user scenarios where a chatbot might hinder a user, thus possibly resulting in a negative assessment. Consequently, it seems best to give users in such situations the choice of system for the respective task so as not to hinder them.

MRQ2.3 What is the business value of chatbots at digital workplaces?

To examine the business or organizational perspective of the chatbot system, it was surveyed which business value can be achieved [MRQ2.3]. Based on the two chatbot instantiations of Study V and Study VI, it was shown that chatbots can be used for IT-support tasks (Meyer von Wolff et al. 2020d) and for business processes (Meyer von Wolff et al. Forthcoming). However, a more focused consideration of the business value was made in Study VI (see Section 3B6.5.4). In doing so, two findings were revealed. First, the evaluation points out that chatbots are time-wise comparable to current business systems (see Figure 43). The lead time for the chatbot was equal or even faster than with the

current business form. In addition, the chatbot's lead time was nearly independent of the users' IT-affinity and process experience. Thus, users can conduct a business process on their own without previous training. This was even mentioned in Study V, as users rate IT-support chatbots faster compared to the current IT-support solutions (see Section 3B5.6.1). Second, the results of Study VI show that with the chatbot system the risk of faulty processes, such as missing or erroneous inputs, can be reduced and process interruptions or cancellations can be avoided (see Table 40). Consequently, the tasks are probably clearer with the chatbot because the users only needed to answer questions and could receive targeted assistance if they had any issues. However, on the downside, the chatbot increased the rate of false-positive process results, such as errors that can only be found manually or with great effort. Thus, the results show that even if a chatbot is used for business processes, human work is still needed to control, check, and verify process results. To sum up, chatbots are capable of providing business processes that can be used without previous training and can reduce the error probability in terms of wrong or missing inputs. However, in the interviews in Study VI it was mentioned that the effort necessary to create a business chatbot should not be underestimated (see Section 3B6.6) (Meyer von Wolff et al. Forthcoming). Even if initial prototypes can be created quickly and with little effort, continuous and costly care and maintenance are required to address problems promptly and correct errors or gaps in the chatbot's knowledge base. Therefore, the costs of chatbots often increase with the runtime and are often set too low at the beginning. Companies should be aware of this and should be willing to use chatbots as a means of improving work quality, even though chatbots may not make a monetary contribution or reduce costs.

MRQ2.4 How to generalize the design knowledge?

Lastly, regarding research complex B, the generalization of the gathered design knowledge was intended [MRQ2.4]. Study VI made the main contribution of answering this sub-meta research question (Meyer von Wolff et al. Forthcoming). In doing so, a *Nascent Design Theory* according to GREGOR/JONES (2007) was derived that includes the components: *purpose and scope*, *constructs*, *principles of form and function*, *artifact mutability*, *testable propositions*, *justificatory knowledge*, and *principles of implementation* (see Table 41) (see Section 3B6.7). Thus, applying the theory, especially by using the constructs, design principles, and artifact mutability, other chatbots independent of a respective company or business use case can be developed. Therefore, it is necessary to derive individual design requirements for the given use case based on the theory to implement one's own chatbot. Consequently, the development of various process-based chatbots in specific and business chatbots in general is possible. In addition, the derived design propositions based on the results of Study VI can be used to assess the possible impacts of a chatbot application at the digital workplace and to evaluate chatbots. Furthermore, the design principles can be reused by researchers in future studies and can be verified using the derived testable propositions.

4.1.3 How Can Practice be Supported Purposefully in Chatbot Projects?

In research complex C, the targeted practice support in chatbot projects was addressed. For this purpose, previous scientific findings should be made available in a form that they can be (re-)used during

the complete lifecycle of chatbots. Therefore, a *Design Science Research* study with three iterations according to HEVNER ET AL. (2004) and HEVNER (2007) was performed. In doing so, a procedure model for chatbot projects was created that can be used to guide chatbot projects in businesses (Study VII) (Meyer von Wolff et al. 2022a).

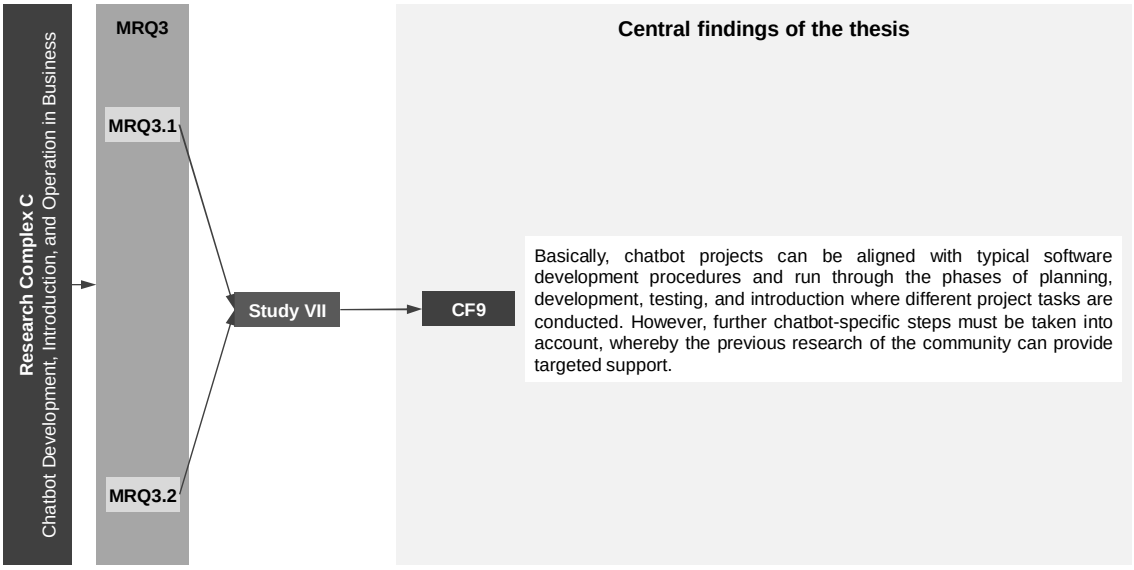

Figure 53 Central Findings of Research Complex C

The study addressed the meta research question on how practice can be supported in chatbot projects [MRQ3]. The research question was further refined by two sub-meta research questions addressing the respective subject areas relevant for research complex C (see Table 3). Study VII provided one central finding based on the chatbot's procedure model, which is discussed in the following based on the two sub-meta research questions (see Figure 53).

MRQ3.1	How can scientific results be used to guide chatbot projects in businesses?

First, it was necessary to examine how existing scientific results can be used to guide chatbot projects [MRQ3.1]. Therefore, existing scientific research contributions must be identified that are viable for usage by practitioners during chatbot projects. Study VII discusses existing research that is suitable for this (see Section 3C7.4) (Meyer von Wolff et al. 2022a). To apply the scientific results in practice, the contributions relevant for the given task should be considered in detail. To that end, the procedure model highlights the individual tasks and the corresponding contributions. Practitioners can use the given research results for the respective task, for example, to define the use case or clarify how the chatbot should be designed. As Study VII in a sense summarizes the previous findings, the six studies can be used to demonstrate how scientific results can be used for chatbot projects in businesses. Study I (Meyer von Wolff et al. 2019a) and Study II (Meyer von Wolff et al. 2020a) can be used for identifying and determining the use case, for example, support, self-service, or information management (see Section 3A1.4.2 or Section 3A2.4.3). In addition, both studies outline possible objectives of the project, such as automation, 24/7 availability, and quality of work improvement (see Section 3A1.4.4 or 3A2.4.4). Additionally, Study III indicates possible challenges during chatbot projects, such as acceptance problems, data security, and integration into the enterprise landscape, that can be taken into account accordingly by planning and undertaking countermeasures (see Section 3A3.4) (Meyer von Wolff et al.

2021b). Furthermore, the design-oriented research studies (Study IV, Study V, and Study VI) outline design recommendations and principles that can be reused and adapted to a new or different chatbot application (Meyer von Wolff et al. Forthcoming; Meyer von Wolff et al. 2020b; Meyer von Wolff et al. 2020d). They also provide examples of how to design a chatbot or how a chatbot may look graphically (e.g., see Section 3B5.5 or Section 3B6.4). Last, Study V and Study VI discuss how chatbots can be evaluated from the viewpoint of users and business, for example, user experience surveys, acceptance measures, and log analysis, and show anticipated effects (see Section 3B5.6 or Section 3B6.5).

MRQ3.2 How should practice-oriented chatbot projects in businesses be structured?

Second, the thesis contributed by proposing a structured procedure model to guide chatbot projects in businesses [MRQ3.2]. According to Study VII, chatbot projects run through four phases, namely *planning phase*, *development phase*, *test phase*, and *operation phase* (see Figure 46-Figure 49) (see Section 3C7.4) (Meyer von Wolff et al. 2022a). In these four phases, up to 41 tasks are carried out, and setbacks or iterations are also possible, allowing a more dynamic approach. Consequently, it was shown that chatbots comply with typical procedure models of software development, such as SCRUM and the waterfall model. Thus, those typical or traditional approaches can also be applied in practice when rolling out chatbots. However, in this case, according to Study VII, chatbot-specific tasks must be considered, such as *selection of the NLP algorithm or chatbot framework*, *creation of the natural language knowledge base*, *defining the chatbot's persona*, and *timely and regular maintenance of the chatbot*. To sum up, to successfully conduct chatbot projects it is important that all phases and the necessary steps of each phase have been completed and that a result has been determined for each of them. Otherwise, steps might be forgotten or decisions were made that cannot be reversed later.

4.2 Implications

The findings of the thesis not only answer the research questions that guided the individual studies, but implications for science and practice can also be derived accordingly. In the following, the implications of the thesis and those that were hinted at in the respective research studies are briefly outlined.

4.2.1 Implications for Science

In terms of explanatory research, the state of the art of chatbots at digital workplaces was derived, and thus the research field could be systematized. By outlining critical research gaps, interesting starting points for future research studies were determined, for example, in the form of open behavioral and design-oriented research questions (see Study I). The open questions were partially answered by the conducted research studies but still offer research potential for future studies. Additionally, regarding the identified application areas and possible usages (see Study I and Study II), viable chatbot instantiations at the digital workplace are outlined and, therefore, starting points for future chatbot research were shown. In particular, the less considered application areas seem to be interesting for future studies, such as workplace education or self-service processes, which the thesis hinted at already. The same can be concluded about the objectives, as they indicate what can be expected from

a chatbot operation (see Study I and Study II). Consequently, they can be used for including them in questionnaires, measurement items, or theories relevant for chatbot applications at the digital workplace. Influencing factors and challenges for chatbots at the digital workplace were also identified (see Study III). Notably, the thesis shows that organizational or management topics, in particular, should be examined in future research, as indicated by the influencing factors and challenges. These topics have been given less consideration to date, and the thesis points out the importance of the factors for chatbot adoption.

Furthermore, in terms of design-oriented research, the thesis outlines design contributions on how chatbots could be designed and implemented at the digital workplace, i.e., for information acquisition, IT-support, and business processes (see Study IV, Study V, and Study VI). In particular, the generalized design principles should be considered in further design studies in order to develop business chatbots in general and process-based chatbots specifically (see Study VI). Consequently, the developed *Nascent Design Theory* according to GREGOR/JONES (2007) should be incorporated in future research when developing chatbots for the business workplace, as generalized recommendations are described and suggestions for verification are given. The developed theory in Study VII represents thereby a scientific design research contribution of level two according to GREGOR/HEVNER (2013). Additionally, the thesis outlines methods on how chatbots can be evaluated (see Study V and Study VI). It was shown that existing and well-established approaches such as acceptance measurements, IT-affinity, and user experience are also viable for chatbot evaluations. Thus, future evaluation studies in chatbot research can be optimized by, for example, incorporating the questionnaires or theories used in the thesis. Consequently, by applying the presented methods, that is, questionnaires, constructs, and theories, future studies can compare their results to those of this thesis. Last, by presenting a procedure model based on the existing scientific research on chatbot applications, two further implications are provided (see Study VI). First, a basis for future studies is provided by showing necessary aspects for the chatbot lifecycle, which can also represent interesting research aspects. Second, a new way of how scientific results can be made available and useable by practitioners is provided in the form of a procedure model. This approach, even if applied for chatbots in this thesis, can easily be adopted for other research projects whenever it is necessary to make results available in a form that they can be applied in practice.

Overall, from the science perspective, the application of chatbots at digital workplaces was examined comprehensively. Relevant topics and subjects for enterprise chatbot research were highlighted on which future studies can build or which can be included in future studies.

4.2.2 Implications for Practice

In terms of practice, the thesis provides plenty of motivation emphasizing the potential of using chatbots at the digital workplace in the business context. Practitioners or companies can rely on the thesis and the described studies if they need scientifically-based information on the adoption of chatbots.

From an organizational perspective, application areas at the digital workplace are discussed in the conducted studies (see Study I and Study II), which can be used when planning a chatbot project. In addition, chatbot functionalities in the form of usages are outlined (see Study II), which can be applied

for decision support in determining the desired chatbot functionalities. Therefore, the thesis provides support in selection decisions. By presenting the possible objectives of a chatbot application, practitioners can judge chatbot projects and their impacts better (see Study I and Study II). It can be identified what is possible with a chatbot and if those objectives match a respective project aim of a company. The results can be used as a guideline for chatbot projects in practice applications or adoption decisions and foster the decision. Furthermore, the thesis provides an overview of influencing factors and challenges from the technical, organizational, individual, and environmental perspectives (see Study III). Challenges are known from the very beginning of the project, and companies can prepare for these preconditions during chatbot implementation or operation. The challenges can be addressed directly to counteract them or to reduce their mostly negative effects on the chatbot's success.

Additionally from a more technical view, the conducted research studies of research complex B provide valuable insights on how chatbots work, how chatbots should be designed, and what chatbots could look like in an enterprise application (see Study IV, Study V, and Study VI). For practitioners, this can guide the development team as starting points and outline necessary aspects to incorporate into the chatbot design. Especially, the design principles and the derived *Nascent Design Theory* (see Study VI) can be used as the starting point based on which individual, company, or task-specific requirements for a respective business task or process can be derived. The evaluations of the chatbots described in this thesis also indicate the benefits to be expected (see Study V and Study VI). In particular, the results verify that chatbots provide a good user experience and usability from the users' perspective. In terms of business value, the lead times of chatbots are comparable with existing business solutions, and the error probability in terms of missing or faulty inputs can be reduced with chatbots. Both aspects are even independent of the users' process experience and IT-affinity. However, it was shown that chatbots are particularly suitable if the respective task is performed rather infrequently. For power user scenarios, chatbots can even tend to hinder the user. Consequently, practitioners can use these results to better evaluate a chatbot application and determine if a chatbot is the right system for the given purpose.

Lastly, especially valuable for businesses is the derived procedure model for chatbots (see Study VII). The proposed model covers the entire chatbot lifecycle from planning to development and testing to operation by showing the respective tasks in the individual phases. Consequently, the results can be used as a guideline for chatbot projects in practice applications or adoption decisions. Therefore, the procedure model helps practitioners by structuring their chatbot operations and allows the target-oriented use of existing scientific contributions and their results. Thus, no project steps are forgotten or wrong decisions made about what should ultimately lead to more successful chatbot projects in businesses.

Overall, the presented findings have a high practice relevance and can guide companies in discussing the utilization of chatbots at the digital workplace on a scientifically sound basis, from the selection of a use case to the development of a respective chatbot.

4.3 Limitations

The thesis contributes to the research on the application of chatbots at digital workplaces in a business context with a scientifically based starting point. However, the overall thesis is subject to some limitations (L*i*) mostly grounded on the conducted research studies that indicate a need for further research. The studies' limitations are already described in the respective chapters of Section 3. In the following, the general limitations of the three research complexes are outlined, and research opportunities to address them in the future are highlighted.

For **research complex A** and the underlying studies, Study I (Meyer von Wolff et al. 2019a), Study II (Meyer von Wolff et al. 2020a), and Study III (Meyer von Wolff et al. 2021b), the following limitations exist.

L1	The literature review is limited to its scope and age of the identified relevant literature

First, even if the state of the art was shown, the literature review of Study I is limited in terms of scope and the age of the literature [L1]. Only literature until the end of 2017 was included. Therefore, there could be newer research and the identified research gaps could no longer exist. Approaches to address this have already been described in this thesis, and the conducted studies address this as well. However, as outlined in the individual conducted studies, still research needs exist, and the continuously growing interest in this topic drives the research relevance of future studies. It seems appropriate to conduct another literature review in future work to cover new research trends and findings that have emerged since 2017, and thus new open research questions can be derived.

L2	The explorative cross-section interview study may be biased by the scope of participating domain experts, their expertise, and their willingness to participate

Second, the results of the cross-section expert study (Study II, Study III) are limited to the origin and experience of the participants and their willingness to participate [L2]. As almost all the experts that participated were German, the results are somewhat limited. However, as the results agree with the identified international literature discussed in Study I, the results regarding application areas and objectives still seem viable and useful for chatbot applications at digital workplaces. Nonetheless, due to the sample composition, it seems reasonable to extend the exploratory research using a larger and more international group of participants to cover the subject as completely as possible and to obtain international insights and experiences from practice.

L3	The results for the application areas and usages, objectives, and influencing factors and challenges are merely exploratory and argumentative

Third, the findings of research complex A are only based on explorative studies and argumentative reasoning [L3]. Therefore, research is necessary to verify the results for the actual viability in practice-oriented studies and reuse by science. Therefore, the results have to be transferred to and examined in actual practice applications. In doing so, the results regarding application areas, objectives, influencing factors, and challenges should be extended and adjusted to reflect the corporate reality.

However, the studies of research complex B already demonstrate the usefulness for the three scenarios of information acquisition, IT-support, and business processes.

Furthermore, the results of **research complex B** are subject to limitations according to Study IV (Meyer von Wolff et al. 2020b), Study V (Meyer von Wolff et al. 2020d), and Study VI (Meyer von Wolff et al. Forthcoming). They are as follows:

L4	Limited scope of the design contributions to the three use cases information acquisition, IT-support, and business processes

First, the design-oriented part of the thesis is based on the three distinct use cases information acquisition (Study IV), IT-support (Study V), and business processes (Study VI), and thus is limited in scope [L4]. As identified in Study I and Study II, several application areas are possible. Consequently, as in the thesis only three application areas were surveyed, the scope should be extended by including further viable application areas, such as education or human resources. Nonetheless, the selected three use cases of the thesis cover a wide range of possible tasks, as identified by the usages in Study II, and outline the chatbots' potential for them. Thus, the three application scenarios for chatbots can still provide a good overview to assess chatbot applications at the digital workplace.

L5	The survey and derivation of requirements and design principles are mostly based on scientific approaches

Second, the requirements and therefore the design principles are mainly identified by scientific contributions (Study V, Study VI), argumentative reasoning (Study V, Study VI), and student surveys (Study IV, Study V) [L5]. Consequently, it may be that the requirements do not reflect actual practice. Therefore, the identified requirements and design principles must be transferred to different business processes and tasks by developing a corresponding chatbot to verify the results. Future studies should also actively survey and include practice-relevant requirements, e.g., via interviews with professionals and observations in the field, to overcome the limitations of a predominantly scientific-based requirements analysis. Nonetheless, as Study VI basically summarizes the design-oriented findings as a nascent design theory and as the experts of the evaluations were quite pleased it seems that the corporate practice was nevertheless well met.

L6	For the design of the business chatbots, anthropomorphism and human characteristics are not included

Third, regarding the design of the developed chatbots, anthropomorphism and human design were deliberately not taken into account, as the focus was on the business functionalities [L6]. However, even if human aspects were nevertheless included in every chatbot to a small extent this focus should be intensified in future work. Especially, the results of Study V and Study VI already show a quite good user experience, which theoretically can only be improved by including anthropomorphic elements according to the associated research stream.

L7	The design-oriented evaluation studies may be biased by the composition of participants and novelty effects, as well as disregarding a long-term or repetitive application

Furthermore, the evaluations concerning the designed chatbots are perhaps somewhat biased due to the participants or novelty aspects, and the scope is limited to one measurement point in a laboratory setting [L7]. In order to mitigate influences, it was attempted to obtain both a comprehensive set of participants and a cross-section in which relevant participants for the respective use case are included. However, as the results underlie the scope of participants, with an extended and international participant group, the results might differ. In particular, in Study IV and Study V, the participants were mostly students. As this group does not represent actual employees of companies, the transferability is hampered, and the studies should be extended to include actual employees in the future. However, students will enter companies sooner or later and can at least be regarded as new employees or employees without experience and therefore provide some useful input. Additionally, the evaluation studies (Study V and Study VI) took place in one moment of time, which can influence the novelty aspect and therefore the result too positively. To eliminate these effects, the surveys should be repeated after some time, which also includes revising the prototypes based on the evaluation results [L5]. In addition, the evaluations were conducted only at one point in time, and therefore the long-term consequence of the application cannot be assessed. Thus, it is also difficult to make statements about the long-term impact or assessment of chatbot applications, especially for repetitive use. Therefore, the next step is to conduct longitudinal studies, preferably in a real company or process, to determine the effects depending on the duration of use. In that way, actual statements about the provided business value in a practical application would be possible.

L8	The nascent design theory is merely based on six design principles and one complete design science research cycle for one application area

Last, the designed artifact of the process-based chatbot for digital workplaces at businesses was based on only one study and the respective six design principles could influence the generalizability negatively [L8]. However, as the design principles are derived comprehensively from user stories, process analysis, and mostly general scientific research on chatbot design for businesses, the results should be viable for generalization. As a consequence, in order to achieve actual confirmable generalization, the design results and, especially, the *Nascent Design Theory* of Study VI have to be transferred and applied to new and further application areas. In doing so, the results can be adjusted and verified to construct a solid design theory.

In addition, also **research complex C** underlies a limitation. This concerns the results of Study VII (Meyer von Wolff et al. 2022a):

L9	The procedure model is theoretical founded on existing scientific results and a three-iterations design science research approach and was not tested in a practical application while conducting a chatbot project

The process artifact of the procedure model for chatbot projects was based on only existent scientific findings and researchers' expertise [L9]. As the model was constructed based on scientific contributions and workshops among researchers, the actual practice perspective is missing. However, the model was

evaluated twice based on two workshops with partially international researchers. As the number of changes decreased between the iterations, the proposed model seems to be of high accuracy scientifically wise and all necessary tasks and scientific findings seem to be included. Nonetheless, practice-related aspects can be overlooked or given less consideration due to this scientific approach. Therefore, the study should be extended by a workshop with practitioners to include their expertise in chatbot projects and the actual business practice. Furthermore, to prove the actual applicability and to verify the model, it is necessary to apply the procedure model in a real case chatbot project. For this purpose, the procedure model should be used for an actual chatbot project in businesses, and the project should be aligned with the model. In doing so, a chatbot project should be conducted according to the procedure model and the fundamental scientific findings to verify the process or identify further adaptations. Consequently, the procedure model can be enhanced and generalized for an application beyond the usage of chatbots at digital workplaces at businesses, and potentially a design theory can be developed.

4.4 Outlook

The application and utilization of chatbots at digital workplaces in business contexts remain an interesting and promising research field. For this, the thesis outlines application areas, objectives, influencing factors, and design recommendations and assessments of the use of chatbots from the perspectives of users and organizations by surveying the research field from a meta and practice-focused viewpoint. Nonetheless, potential for future research still exists to build on the work presented in the thesis and extend the scientific knowledge base. Concerning this, an overview of possible research directions has already been given in FØLSTAD ET AL. (2021) as the result of discussions among international chatbot researchers at the CONVERSATIONS 2019 workshop (CONVERSATIONS 2019). In what follows, other interesting research topics are briefly pointed out.

To begin with, education, e-learning, or training with chatbots in university or school settings is currently a major research area, and chatbots have proven themselves to be viable in this context; see, e.g., HOBERT (2019b) or WINKLER/SÖLLNER (2018). Therefore, it seems reasonable to transfer the results to a business application where chatbots are used for internal education, such as learning during free time, or while working. Notably, this application area was mentioned in Study I and Study II, while at the same time outlining missing research on this. Consequently, it seems interesting to dive into this specific research stream and survey the suitability and design of chatbots for learning on the job.

Second, in terms of business processes, the thesis has indicated the necessity of integration with other enterprise systems, such as financial systems for billing. Therefore, future research should examine this integration with the application system landscape in detail and investigate whether the integration of enterprise software is possible and what is necessary for this. The focus could be on the available integration methods and their requirements to see if they are suitable for natural language applications or if they need to be extended or even redesigned. In addition, chatbots have been shown not to be appropriate for system replacements, but rather as a new user interface or access channel. Therefore, especially for inexperienced or casual users, a user-friendly and easy-to-use interface is provided.

However, as an interplay with other systems is necessary, future studies can examine the integration of chatbots into the application landscape in detail, as well as the interplay with classic menu-driven, form-based, or graphical user interfaces.

In addition, a *Nascent Design Theory* was derived for the case of business process chatbots. With further advances in chatbot technology, e.g., in natural language processing, artificial intelligence in general, or new results regarding chatbot design, the question arises of whether the derived theory will continue to be suitable only for enterprises in the long term, or whether the technology will evolve into a general design theory for chatbots, that is, a level three theory (Gregor/Hevner 2013). As of now, the technology seems viable for process-based chatbots specifically and for business chatbots in general. However, this may only be an intermediate state and with further developments and future research contributions, an actual generalized theory for chatbots can be created. Therefore, future researchers can build upon the derived *Nascent Design Theory* to enhance and extend it.

Furthermore, currently, the chatbot knowledge base is mostly static, and all knowledge and answers must be created elaborately in advance and maintained timely during operation. Due to continuous advances in artificial intelligence in terms of data mining, text mining, and language understanding, it seems viable to investigate how the knowledge base can be provided and improved automatically or dynamically. For example, it could be investigated how text mining can be used to generate the chatbot knowledge base and how the knowledge base can be maintained in doing so. Consequently, light can also be shed on concepts such as knowledge-as-a-service so that the desired knowledge for a chatbot can be easily purchased and integrated without maintenance or customization.

Additionally, as identified by the previous studies, e.g., Study VII, several platforms for creating chatbots exist, e.g., listed in CHATBOTS.ORG (2021); however, users often do have not the necessary knowledge. Therefore, it seems reasonable to examine user-friendly chatbot development and creation platforms. For example, the trend for low-code or graphical development frameworks seems suitable, as with these approaches even inexperienced developers or non-technical employees, e.g., support staff, are able to carry out developments and knowledge provision. In particular, the survey of graphical chatbot modeling or rather dialog modeling to create chatbots' knowledge and dialogs seem appropriate. In this context, as with knowledge-as-a-service, chatbots-as-a-service could also be addressed, so that ready-made chatbots or partially preconfigured chatbots can simply be integrated as a service in business contexts.

Another interesting research topic is the interconnection or interplay between chatbots. As indicated in the thesis, chatbots work best the more focused on a topic or function they are; for example, it is easier to provide the necessary knowledge or maintain them. For this interplay, it could be interesting to apply the concept of multi-agent systems to chatbots (e.g., Brazier et al. 1995; Jennings 2001), as suggested by ZOLITSCHKA (2020). In this case, every chatbot functions as an agent or service for one specific function, and all the chatbots communicate with each other if the necessary functionality is provided by a different chatbot service. However, the user accesses only one natural language-based user interface and does not notice the internal operating or switching of the appropriate chatbot agent. This concept seems also reasonable, as the maintenance effort can be targeted and reduced to one specific chatbot agent, and in the case of information provision, it is easier to provide the knowledge. However, at the

same time, the integration effort could be increased, and some sort of middleware is necessary. Therefore, future studies should investigate this new kind of multi chatbot-agent system and study its design and impact.

To sum up, the thesis comprehensively examined the application and utilization of chatbots in business contexts and created a solid foundation by outlining application areas, organizational and technical requirements, and recommendations for chatbot design valid for the digital workplace. Grounding on this knowledge, a deep dive into related research topics is possible in order to extend chatbot research in business contexts even further.

Appendix

A1 Published Contributions of the Overall Research Project

Foundation	Chatbot	Digital Workplace	State of the Art and Research Relevance	State of the Practice	Usages	Application Areas	Objectives	Influencing Factors and Challenges	Requirements Analysis for Information Acquisition	User Acceptance for IT-Support Chatbots	Process-based Chatbots for Business Processes	Requirements and Design	Evaluation	Procedure Model for Chatbot Projects in Business	Conference/Journal	Reference
	✗	✗	✗												Arbeitsbericht I 2018	(Meyer von Wolff/Schumann 2018)
	✗	✗			✗	✗	✗	✗							Arbeitsbericht II 2019	(Meyer von Wolff/Schumann 2019)
					✗	✗									AMCIS 2019	(Meyer von Wolff et al. 2019b)
										✗					AMCIS 2020	(Meyer von Wolff et al. 2020d)
												✗			AMCIS 2021	(Meyer von Wolff et al. 2021a)
									✗						Conversations 2019	(Meyer von Wolff et al. 2020b)
	✗	✗	✗												HICSS 2019	(Meyer von Wolff et al. 2019a)
														✗	HICSS 2022	(Meyer von Wolff et al. 2022a)
								✗							WI 2021	(Meyer von Wolff et al. 2021b)
						✗	✗	✗							HMD 333	(Meyer von Wolff et al. 2020c)
					✗	✗	✗	✗							Edition HMD	(Meyer von Wolff et al. 2022b)
	✗	✗			✗	✗	✗								PAJAIS 2020	(Meyer von Wolff et al. 2020a)
												✗	✗		THCI 2022	(Meyer von Wolff et al. Forthcoming)

Table 42 Appendix 1 - Overview of all Contributions regarding the Research Aim

A2 Literature Review

A2.1 Morphological Box

Characteristic		Category			
Type		**naturally linguistically**		**mathematical-statistical**	
Focus		**Research outcomes**	**Research methods**	Theories	**Practices or applications**
Aim	**Formulation**	Not explicit		**Explicit**	
	Content	Integration	Criticism		**Central issues**
Perspective		**Neutral**		Position	
Literature	**Selection**	Not explicit		**Explicit**	
	Coverage	Central or pivotal	Representative	Exhaustive with selective citation	**Exhaustive**
Organization		Historical	**Conceptual**	Methodological	
Audience		General public	Practitioners	**General scholars**	**Specialized scholars**
Future Research		Not explicit		**Explicit**	

***Note**: Based on (Cooper 1988) and (Fettke 2006)*

Table 43 Appendix 2.1 - Morphological Box of Study I

A2.2 Search Strings I

Database	Searchstring	Search hits		reviewed	relevant	Paper
ACM	("digital workplace" OR "digital workspace" OR "digital office" OR "future workplace" OR "future workspace" OR "knowledge work" OR "office automation") AND ("digital assistant" OR "digital assistance system" OR "digital agent" OR "intelligent assistant" OR "intelligent assistance system" OR "smart office" OR "smart work" OR "intelligent agent" OR "artificial intelligence")	110	407	28	6	(Følstad/Brandtzæg 2017), (Kiseleva et al. 2016), (Radlinski/Craswell 2017), (Vtyurina et al. 2017), (Zamora 2017a), (Zamora 2017b)
	("digital workplace" OR "digital workspace" OR "digital office" OR "future workplace" OR "future workspace" OR "knowledge work" OR "office automation") AND ("software agent")	5				
	("virtual assistant" OR "virtueller Assistent" OR "chatbot" OR "intelligenter persönlicher Assistent" OR "intelligent personal assistant" OR "Sprachassistent")	288				
	("Chatbots" OR "Chatterbots" OR "Conversational Agent" OR "Natural Language Dialog System" OR "Virtual Assistant" OR "Intelligent Personal Assistant") AND ("office work" OR "office communication" OR "workplace" OR "workspace" OR "knowledge work")	4				
AISEL	("digital workplace" OR "digital workspace" OR "digital office" OR "future workplace" OR "future workspace" OR "knowledge work" OR "office automation") AND ("software agent")	32	759	41	0	–
	("digital workplace" OR "digital workspace" OR "digital office" OR "future workplace" OR "future workspace" OR "knowledge work" OR "office automation") AND ("digital assistant" OR "digital assistance system" OR "digital agent" OR "intelligent assistant" OR "intelligent assistance system" OR "smart office" OR "smart work" OR "intelligent agent" OR "artificial intelligence")	312				
	("digital workplace" OR "digital workspace" OR "digital office" OR "future workplace" OR "future workspace" OR "knowledge work" OR "office automation" OR "intelligent office" OR "smart office" OR "intelligent work" OR "smart work" OR "office workspace") AND ("virtual assistant" OR "chatbot" OR "intelligent personal assistant")	2				
	("Chatbots" OR "Chatterbots" OR "Conversational Agent" OR "Natural Language Dialog System" OR "Virtual Assistant" OR "Intelligent Personal Assistant") AND ("office work" OR "office communication" OR "workplace" OR "workspace" OR "knowledge work")	14				
	("Chatterbots" OR "Conversational Agent" OR "Natural Language Dialog System" OR "Dialogsystem")	126				
	("virtual assistant" OR "virtueller Assistent" OR "chatbot" OR "intelligenter persönlicher Assistent" OR "intelligent personal assistant" OR "Sprachassistent")	273				
EbscoHost	("digitaler arbeitsplatz" OR "digitale Arbeitsumgebung" OR "digitale Arbeitswelt" OR "digitales Büro" OR "Arbeitsplatz der Zukunft" OR "Wissensarbeit" OR "Büroautomation") AND ("digitale Assistenten" OR "digitale Assistenzsysteme" OR "digitaler Agent" OR "intelligente Assistenten" OR "intelligente assistenzsysteme" OR "intelligentes Büro" OR "intelligente Arbeit" OR "software agent" OR "intelligenter Agent" OR "künstliche Intelligenz")	1	1265	60	5	(Aquino 2012), (Gyton/Jeffery 2017), (Han 2017), (Korenzenikowski 2017), (Masterson 2015)
	("digital workplace" OR "digital workspace" OR "digital office" OR "future workplace" OR "future workspace" OR "knowledge work" OR "office automation") AND ("digital assistant" OR "digital assistance system" OR "digital agent" OR "intelligent assistant" OR "intelligent assistance system" OR "smart office" OR "smart work" OR "software agent" OR "intelligent agent" OR "artificial intelligence")	31				
	("digitaler arbeitsplatz" OR "digitale Arbeitsumgebung" OR "digitale Arbeitswelt" OR "digitales Büro" OR "Arbeitsplatz der Zukunft" OR "Wissensarbeit" OR "Büroautomation") AND ("digitale Assistenten" OR "digitale Assistenzsysteme" OR "digitaler Agent" OR "intelligente Assistenten" OR "intelligente assistenzsysteme" OR "intelligentes Büro" OR "intelligente Arbeit" OR "software agent" OR "intelligenter Agent" OR "künstliche Intelligenz")	1				
	("digital workplace" OR "digital workspace" OR "digital office" OR "future workplace" OR "future workspace" OR "knowledge work" OR "office automation") AND ("digital assistant" OR "digital assistance system" OR "digital agent" OR "intelligent assistant" OR "intelligent assistance system" OR "smart office" OR "smart work" OR "software agent" OR "intelligent agent" OR "artificial intelligence")	584				
	("virtual assistant" OR "virtueller Assistent" OR "chatbot" OR "intelligenter persönlicher Assistent" OR "intelligent personal assistant" OR "Sprachassistent")	400				
	("virtual assistant" OR "virtueller Assistent" OR "chatbot" OR "intelligenter persönlicher Assistent" OR "intelligent personal assistant" OR "Sprachassistent")	10				
	("Chatbots" OR "Chatterbots" OR "Conversational Agent" OR "Natural Language Dialog System" OR "Virtual Assistant" OR "Intelligent Personal Assistant") AND ("office work" OR "office communication" OR "workplace" OR "workspace" OR "knowledge work")	222				
	("digital workplace" OR "digital workspace" OR "digital office" OR "future workplace" OR "future workspace" OR "knowledge work" OR "office automation" OR "intelligent office" OR "smart office" OR "intelligent work" OR "smart work" OR "office workspace") AND ("virtual assistant" OR "chatbot" OR "intelligent personal assistant")	3				
	("digital workplace" OR "digital workspace" OR "digital office" OR "future workplace" OR "future workspace" OR "knowledge work" OR "office automation" OR "intelligent office" OR "smart office" OR "intelligent work" OR "smart work" OR "office workspace") AND ("virtual assistant" OR "chatbot" OR "intelligent personal assistant")	13				
EmeraldInsight	("digital workplace" OR "digital workspace" OR "digital office" OR "future workplace" OR "future workspace" OR "knowledge work" OR "office automation") AND ("digital assistant" OR "digital assistance system" OR "digital agent" OR "intelligent assistant" OR "intelligent assistance system" OR "smart office" OR "smart work" OR "software agent" OR "intelligent agent" OR "artificial intelligence")	163	209	17	1	(Carayannopoulos 2018)
	("virtual assistant" OR "virtueller Assistent" OR "chatbot" OR "intelligenter persönlicher Assistent" OR "intelligent personal assistant" OR "Sprachassistent")	34				
	("Chatbots" OR "Chatterbots" OR "Conversational Agent" OR "Natural Language Dialog System" OR "Virtual Assistant" OR "Intelligent Personal Assistant") AND ("office work" OR "office communication" OR "workplace" OR "workspace" OR "knowledge work")	12				
IEEE	("knowledge work" OR "office automation") AND ("digital assistant" OR "digital agent" OR "intelligent assistant" OR "smart office" OR "smart work" OR "software agent" OR "intelligent agent" OR "artificial intelligence")	111	1647	81	9	(Al-Zubaide/Issa 2011), (Angga et al. 2015), (Augello et al. 2012), (Bang et al. 2015), (Lebeuf et al. 2018), (Ranoliya et al. 2017), (Sarikaya 2017), (Satu et al. 2015), (Setiaji/Wibowo 2016)
	("knowledge work" OR "office automation") AND ("digital assistant" OR "digital agent" OR "intelligent assistant" OR "smart office" OR "smart work" OR "software agent" OR "intelligent agent" OR "artificial intelligence")	951				
	("digital workplace" OR "digital office" OR "future workplace" OR "knowledge work" OR "office automation" OR "intelligent office" OR "smart office" OR "intelligent work" OR "smart work" OR "office workspace") AND ("virtual assistant" OR "chatbot" OR "intelligent personal assistant")	8				
	("Chatbots" OR "Chatterbots" OR "Conversational Agent" OR "Natural Language Dialog System" OR "Virtual Assistant" OR "Intelligent Personal Assistant") AND ("office work" OR "office communication" OR "workplace" OR "workspace" OR "knowledge work")	83				
	("virtual assistant" OR "virtueller Assistent" OR "chatbot" OR "intelligenter persönlicher Assistent" OR "intelligent personal assistant" OR "Sprachassistent")	494				

***Note**: only the search strings which have results are shown*

Table 44 Appendix 2.2 – Search Strings I of Study I

A2.3 Search Strings II

Database	Searchstring	Search hits		reviewed	relevant	Paper
ScienceDirect	({digital workplace} OR {digital workspace} OR {digital office} OR {future workplace} OR {future workspace} OR {knowledge work} OR {office automation}) AND ({digital assistant} OR {digital assistance system} OR {digital agent} OR {intelligent assistant} OR {intelligent assistance system} OR {smart office} OR {smart work} OR {intelligent agent} OR {artificial intelligence})	1440	1879	40	1	(Chakrabarti/Luger 2015)
	({digital workplace} OR {digital workspace} OR {digital office} OR {future workplace} OR {future workspace} OR {knowledge work} OR {office automation}) AND ({software agent})	47				
	({digital workplace} OR {digital workspace} OR {digital office} OR {future workplace} OR {future workspace} OR {knowledge work} OR {office automation} OR {intelligent office} OR {smart office} OR {intelligent work} OR {smart work} OR {office workspace}) AND ({virtual assistant} OR {chatbot} OR {intelligent personal assistant})	2				
	("virtual assistant" OR "virtueller Assistent" OR "chatbot" OR "intelligenter persönlicher Assistent" OR "intelligent personal assistant" OR "Sprachassistent")	319				
	("Chatbots" OR "Chatterbots" OR "Conversational Agent" OR "Natural Language Dialog System" OR "Virtual Assistant" OR "Intelligent Personal Assistant") AND ("office work" OR "office communication" OR "workplace" OR "workspace" OR "knowledge work")	71				
SpringerLink	("digitaler arbeitsplatz" OR "digitale Arbeitsumgebung" OR "digitale Arbeitswelt" OR "digitales Büro" OR "Arbeitsplatz der Zukunft" OR "Wissensarbeit" OR "Büroautomation") AND ("digitale Assistenten" OR "digitale Assistenzsysteme" OR "digitaler Agent" OR "intelligente Assistenten" OR "intelligente assistenzsysteme" OR "intelligentes Büro" OR "intelligente Arbeit" OR "software agent" OR "intelligenter Agent" OR "künstliche Intelligenz")	119	2574	42	5	(Berg 2013), (Chai et al. 2001), (Deryugina 2010), (Henrich 2017), (Montero/Araki 2005)
	("digital workplace" OR "digital workspace" OR "digital office" OR "future workplace" OR "future workspace" OR "knowledge work" OR "office automation") AND ("digital assistant" OR "digital assistance system" OR "digital agent" OR "intelligent assistant" OR "intelligent assistance system" OR "smart office" OR "smart work" OR "software agent" OR "intelligent agent" OR "artificial intelligence")	2145				
	("digitaler arbeitsplatz" OR "digitale Arbeitsumgebung" OR "digitale Arbeitswelt" OR "digitales Büro" OR "intelligentes Büro" OR "intelligente Arbeit" OR "Arbeitsplatz der Zukunft" OR "Wissensarbeit" OR "Büroautomation" OR "Büroarbeitsplatz") AND ("intelligent persönlich Assistent" OR "Sprachassistent" OR "Chatbot" OR "virtueller Assitent")	3				
	("virtual assistant" OR "virtueller Assistent" OR "chatbot" OR "intelligenter persönlicher Assistent" OR "intelligent personal assistant" OR "Sprachassistent")	223				
	("Chatbots" OR "Chatterbots" OR "Dialog System" OR "Sprachassistent" OR "Virtueller Assistent" OR "intelligenter persönlicher Assistent") AND ("Büroarbeit" OR "Bürokommunikation" OR "Büroarbeitsplatz" OR "Wissensarbeit")	2				
	("Chatbots" OR "Chatterbots" OR "Conversational Agent" OR "Natural Language Dialog System" OR "Virtual Assistant" OR "Intelligent Personal Assistant") AND ("office work" OR "office communication" OR "workplace" OR "workspace" OR "knowledge work")	79				
	("digital workplace" OR "digital workspace" OR "digital office" OR "future workplace" OR "future workspace" OR "knowledge work" OR "office automation" OR "intelligent office" OR "smart office" OR "intelligent work" OR "smart work" OR "office workspace") AND ("virtual assistant" OR "chatbot" OR "intelligent personal assistant")	3				
WISO	("digitaler arbeitsplatz" OR "digitale Arbeitsumgebung" OR "digitale Arbeitswelt" OR "digitales Büro" OR "Arbeitsplatz der Zukunft" OR "Wissensarbeit" OR "Büroautomation") AND ("digitale Assistenten" OR "digitale Assistenzsysteme" OR "digitaler Agent" OR "intelligente Assistenten" OR "intelligente assistenzsysteme" OR "software agent" OR "intelligentes Büro" OR "intelligente Arbeit" OR "intelligenter Agent" OR "künstliche Intelligenz")	72	1124	103	12	(Bager 2016); (Bott 2017), (Brunotte 2017), (Dämon 2017), (Grodzietzki 2017), (Heckel/Ermisch 2017), (Kuhn 2017), (Panser 2017), (Rüdel/Seibold 2017), (Schäffner 2017), (Schonschek 2017), (Zim 2017)
	("digital workplace" OR "digital workspace" OR "digital office" OR "future workplace" OR "future workspace" OR "knowledge work" OR "office automation") AND ("digital assistant" OR "digital assistance system" OR "digital agent" OR "intelligent assistant" OR "intelligent assistance system" OR "smart office" OR "smart work" OR "intelligent agent" OR "artificial intelligence")	32				
	("digitaler arbeitsplatz" OR "digitale Arbeitsumgebung" OR "digitale Arbeitswelt" OR "digitales Büro" OR "intelligentes Büro" OR "intelligente Arbeit" OR "Arbeitsplatz der Zukunft" OR "Wissensarbeit" OR "Büroautomation" OR "Büroarbeitsplatz") AND ("intelligent persönlich Assistent" OR "Sprachassistent" OR "Chatbot" OR "virtueller Assitent")	2				
	("digital workplace" OR "digital workspace" OR "digital office" OR "future workplace" OR "future workspace" OR "knowledge work" OR "office automation" OR "intelligent office" OR "smart office" OR "intelligent work" OR "smart work" OR "office workspace") AND ("virtual assistant" OR "chatbot" OR "intelligent personal assistant")	7				
	("Chatbots" OR "Chatterbots" OR "Dialog System" OR "Sprachassistent" OR "Virtueller Assistent" OR "intelligenter persönlicher Assistent") AND ("Büroarbeit" OR "Bürokommunikation" OR "Büroarbeitsplatz" OR "Wissensarbeit")	9				
	("Chatbots" OR "Chatterbots" OR "Conversational Agent" OR "Natural Language Dialog System" OR "Virtual Assistant" OR "Intelligent Personal Assistant") AND ("office work" OR "office communication" OR "workplace" OR "workspace" OR "knowledge work")	17				
	("virtual assistant" OR "virtueller Assistent" OR "chatbot" OR "intelligenter persönlicher Assistent" OR "intelligent personal assistant" OR "Sprachassistent")	985				
Foreward and backward search				28	13	(Chakrabarti/Luger 2012), (Fonte Mikic et al. 2009b), (Klopfenstein et al. 2017), (Lebeuf et al. 2017), (Fonte Mikic et al. 2009a), (Neves et al. 2006), (Quarteroni/Manandhar 2007), (Reshmi/BalaKrishnan 2016), (Shawar 2008), (Shawar et al. 2005), (Shawar/Atwell 2007a), (Strehlitz 2017), (Vaziri et al. 2017)

***Note**: only the search strings which have results are shown*

Table 45 Appendix 2.3 – Search Strings II of Study I

A2.4 Classification Matrix

Paper	Criteria	Language	Publication type	Audience	Application area						Potential																Objective						Design contribution				
					CS	IA	ET	SS	CW	WF	P1	P11	P12	P13	P14	P15	P16	P17	P18	P2	P21	P22	P23	P24	P25	P26	P3	O1	O2	O3	O4	O5	O6	R	C	P	E	D
ACM																																					
Følstad/Brandtzæg 2017	2	E	P	P						●						●					●				●		●										
Kiseleva et al. 2016	2	E	C	S		●					●					●											●	●	●							●	
Radlinski/Craswell 2017	2	E	C	S		●					●				●						●						●							●			
Vtyurina et al. 2017	2	E	C	S		●					●																●									●	
Zamora 2017a	2	E	C	S						●	●					●	●			●	●			●	●		●		●	●		●				●	
Zamora 2017b	2	E	C	S						●						●	●				●			●	●		●									●	
EbscoHost																																					
Aquino 2012	2	E	P	P	●																●			●			●			●							
Gyton/Jeffery 2017	1	E	P	P				●				●	●									●			●		●					●					
Han 2017	1	E	P	P			●				●	●														●	●					●					
Korenzenikowski 2017	2	E	P	P	●							●	●												●		●		●		●	●					
Masterson 2015	2	E	P	P	●						●										●			●		●	●					●					
EmeraldInsight																																					
Carayannopoulos 2018	2	E	J	S		●					●																●								●	●	
IEEE Explore																																					
Al-Zubaide/Issa 2011	2	E	C	S		●					●	●															●							●			
Angga et al. 2015	2	E	C	S						●	●		●													●	●							●			
Augello et al. 2012	2	E	C	S	●										●												●							●			
Bang et al. 2015	2	E	C	S						●	●																●							●		●	
Lebeuf et al. 2018	2	E	J	P						●																	●	●	●			●					
Ranoliya et al. 2017	2	E	C	S		●						●															●				●	●		●	●		
Sarikaya 2017	2	E	J	P						●	●	●													●	●	●		●			●					
Satu et al. 2015	2	E	C	S						●																	●				●						
Setiaji/Wibowo 2016	2	E	C	S		●							●														●							●	●		
ScienceDirekt																																					
Chakrabarti/Luger 2015	1	E	J	S	●								●											●							●			●		●	
SpringerLink																																					
Berg 2013	2	G	P	P						●					●					●	●			●			●						●				
Chai et al. 2001	2	E	J	S	●																						●		●					●	●	●	
Deryugina 2010	2	E	J	S						●	●				●											●	●										
Henrich 2017	1	G	P	P				●					●							●	●	●		●			●					●					
Montero/Araki 2005	2	E	C	S						●																	●							●		●	
WISO																																					
Bager 2016	2	G	P	P						●	●		●								●						●	●									
Bott 2017	1	G	P	P	●								●							●			●							●		●					
Brunotte 2017	2	G	P	P	●								●								●									●	●						
Dämon 2017	1	G	P	P				●					●									●		●			●					●					
Grodzietzki 2017	2	G	P	P						●				●													●					●					
Heckel/Ermisch 2017	2	G	P	P	●							●	●								●	●										●					
Kuhn 2017	2	G	P	P	●										●						●						●					●					
Panser 2017	2	G	P	P						●	●		●		●			●				●				●	●		●	●	●						
Rüdel/Seibold 2017	2	G	P	P	●						●		●									●		●			●			●							
Schäffner 2017	1	G	P	P						●										●		●					●	●	●	●		●					
Schonschek 2017	2	G	P	P	●						●	●			●	●	●			●	●				●		●					●					
Zirn 2017	2	G	P	P						●	●				●				●		●						●			●							
Backward & Forward Search																																					
Chakrabarti/Luger 2012	2	E	C	S	●							●																		●			●		●	
Klopfenstein et al. 2017	2	E	C	S						●																	●	●									
Lebeuf et al. 2017	1	E	C	S					●		●													●	●	●	●	●									
Fonte Mikic et al. 2009a	2	E	C	S			●																			●	●							●	●		
Fonte Mikic et al. 2009b	2	E	J	S			●																			●	●								●		
Neves et al. 2006	2	E	C	S						●																	●							●		●	
Quarteroni/Manandhar 2007	2	E	C	S		●					●																●							●	●	●	
Reshmi/BalaKrishnan 2016	2	E	J	S		●					●																●							●	●		
Shawar 2008	2	E	C	S		●						●															●							●	●		
Shawar et al. 2005	2	E	C	S		●						●															●							●	●	●	●
Shawar/Atwell 2007 a	2	E	J	S						●	●	●									●					●	●							●	●		
Strehlitz 2017	1	G	P	P	●								●									●					●					●					
Vaziri et al. 2017	2	E	C	S						●	●																●					●		●	●		

Legend:

Language: G=German; E=Englisch

Type: J=Scientific journal; C=Conference proceeding; P=Practice journal

Application area: CS=Customer support; IA=Information acquisition; ET=Education and training; SS=Self-service; CW=Collaborative work; WF=Without focus

Potential: P1=Information search tasks, P11=Acquisition of FAQs, P12=Answer customer questions, P13=Answer employee questions, P14=Searching for products, P15=Query weather information, P16=Query traffic information,P17=Query of tasks and appointments, P18=Provide maintenance information;
P2=Standardized routine processes, P21=Shopping, P22=Employee Self-service, P23=Customer Self-service, P24=Banking, P25=Arrange appointments and meetings, P26=Setting up reminders;

Objective: O1=Natural language user interface to information systems ; O2=Uniformly, device-independent and mobile access to application systems ; O3=Increase efficiency and productivity; O4=Decrease of time effort; O5=Reduce of costs; O6=Relieve employees by takeover / automate tasks

Design contribution: R=Requirements; C=Concept; P=Prototype; E=Evaluation; D=Design principles

Table 46 Appendix 2.4 – Classification Matrix of Study I

A2.5 Descriptive Statistics

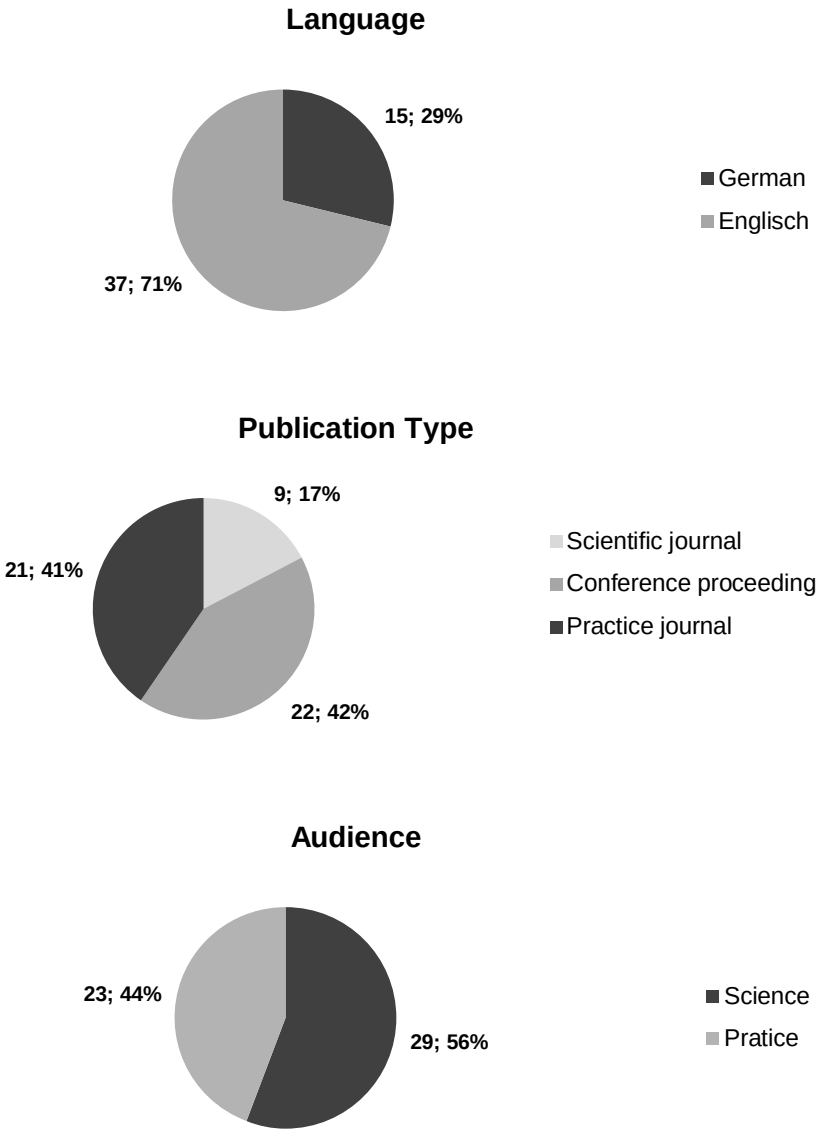

Figure 54 Appendix 2.5 – Descriptive Statistics of Study I

A2.6 Potentials of Chatbots

Potentials			Reference
P1	**Information search tasks**		(Al-Zubaide/Issa 2011; Angga et al. 2015; Augello et al. 2012; Bager 2016; Bang et al. 2015; Berg 2013; Bott 2017; Brunotte 2017; Carayannopoulos 2018; Chakrabarti/Luger 2012; Chakrabarti/Luger 2015; Dämon 2017; Deryugina 2010; Følstad/Brandtzæg 2017; Grodzietzki 2017; Gyton/Jeffsry 2017; Han 2017; Heckel/Ermisch 2017; Henrich 2017; Kiseleva et al. 2016; Korenziowski 2017; Kuhn 2017; Lebeuf et al. 2017; Lebeuf et al. 2018; Masterson 2015; Panser 2017; Quarteroni/Manandhar 2007; Radlinski/Craswell 2017; Ranoliya et al. 2017; Reshmi/Balakrishnan 2016; Rüdel/Seibold 2017; Sarikaya 2017; Schonschek 2017; Setiaji/Wibowo 2016; Shawar et al. 2005; Shawar 2008; Shawar/Atwell 2007a; Strehlitz 2017; Vaziri et al. 2017; Vtyurina et al. 2017; Zamora 2017a; Zamora 2017b; Zirn 2017)
	$P1_1$	Acquisiton of FAQs	
	$P1_2$	Answer customer questions	
	$P1_3$	Answer employee questions	
	$P1_4$	Searching for products, -data, and -information	
	$P1_5$	Query weather information	
	$P1_6$	Query traffic information	
	$P1_7$	Querry of tasks and appointments	
	$P1_8$	Provide maintenance information	
P2	**Standard routine processes**		(Aquino 2012; Bager 2016; Berg 2013; Bott 2017; Brunotte 2017; Chakrabarti/Luger 2015; Dämon 2017; Følstad/Brandtzæg 2017; Gyton/Jeffsry 2017; Han 2017; Heckel/Ermisch 2017; Henrich 2017; Korenziowski 2017; Kuhn 2017; Lebeuf et al. 2017; Masterson 2015; Panser 2017; Radlinski/Craswell 2017; Rüdel/Seibold 2017; Sarikaya 2017; Schäffner 2017; Schonschek 2017; Shawar/Atwell 2007a; Strehlitz 2017; Zamora 2017a; Zamora 2017b; Zirn 2017)
	$P2_1$	Shopping	
	$P2_2$	Employee self-service	
	$P2_3$	Customer self-service	
	$P2_4$	Banking	
	$P2_5$	Arrange appointments and meetings	
	$P2_6$	Setting up reminders	
P3	**Teaching and learning tasks**		(Angga et al. 2015; Deryugina 2010; Han 2017; Lebeuf et al. 2017; Masterson 2015; Mikic Fonte et al. 2009a; Mikic Fonte et al. 2009b; Panser 2017; Shawar/Atwell 2007a)

Table 47 Appendix 2.6 – Potentials of Chatbots of Study I

A2.7 Objectives of Chatbots

Objectives		Reference
O1	Natural language user interface to information systems	(Al-Zubaide/Issa 2011; Angga et al. 2015; Aquino 2012; Augello et al. 2012; Bager 2016; Bang et al. 2015; Berg 2013; Carayannopoulos 2018; Chai et al. 2001; Dämon 2017; Deryugina 2010; Følstad/Brandtzæg 2017; Grodzietzki 2017; Gyton/Jeffsry 2017; Han 2017; Henrich 2017; Kiseleva et al. 2016; Klopfenstein et al. 2017; Korenziowski 2017; Kuhn 2017; Lebeuf et al. 2017; Lebeuf et al. 2018; Masterson 2015; Mikic Fonte et al. 2009a; Mikic Fonte et al. 2009b; Montero/Araki 2005; Neves et al. 2006; Panser 2017; Quarteroni/Manandhar 2007; Radlinski/Craswell 2017; Ranoliya et al. 2017; Reshmi/Balakrishnan 2016; Rüdel/Seibold 2017; Sarikaya 2017; Satu et al. 2015; Schäffner 2017; Schonschek 2017; Setiaji/Wibowo 2016; Shawar et al. 2005; Shawar 2008; Shawar/Atwell 2007a; Strehlitz 2017; Vaziri et al. 2017; Vtyurina et al. 2017; Zamora 2017a; Zamora 2017b; Zirn 2017)
O2	Uniformly, device-independent and mobile access to application systems	(Bager 2016; Kiseleva et al. 2016; Klopfenstein et al. 2017; Lebeuf et al. 2017; Lebeuf et al. 2018; Schäffner 2017)
O3	Increase efficiency and productivity of work	(Chai et al. 2001; Kiseleva et al. 2016; Korenziowski 2017; Lebeuf et al. 2018; Panser 2017; Sarikaya 2017; Schäffner 2017; Zamora 2017a)
O4	Decrease of time effort	(Aquino 2012; Bott 2017; Brunotte 2017; Panser 2017; Rüdel/Seibold 2017; Schäffner 2017; Zamora 2017a; Zirn 2017)
O5	Reduce of costs	(Brunotte 2017; Chakrabarti/Luger 2012; Chakrabarti/Luger 2015; Korenziowski 2017; Panser 2017; Ranoliya et al. 2017; Satu et al. 2015)
O6	Relieve employees by take over / automate tasks	(Bott 2017; Dämon 2017; Grodzietzki 2017; Gyton/Jeffsry 2017; Han 2017; Heckel/Ermisch 2017; Henrich 2017; Korenziowski 2017; Kuhn 2017; Lebeuf et al. 2018; Masterson 2015; Ranoliya et al. 2017; Sarikaya 2017; Schäffner 2017; Schonschek 2017; Strehlitz 2017; Vaziri et al. 2017; Zamora 2017a)

Table 48 Appendix 2.7 – Objectives of Chatbots of Study I

A3 Qualitative Empirical Cross-Section Interview Study

A3.1 Pre-Questionnaire[28]

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Wirtschaftswissenschaftliche Fakultät
Professur für Anwendungssysteme und E-Business

Einsatz von Chatbots am digitalen Büroarbeitsplatz

Vorfragebogen zur Qualitativ-empirischen Untersuchung

Sehr geehrte Interviewteilnehmerin, sehr geehrter Interviewteilnehmer,

Sie haben sich bereit erklärt, im Rahmen des oben genannten Forschungsprojektes an einem Interview teilzunehmen. Hierfür sollen im Vorfeld einige Daten zu verschiedenen Themenblöcken abgefragt werden, um den Informationsstatus zur untersuchten Thematik sowie demografische Daten zu erfassen. Durch diese Daten können wir im Interview gezielter auf Ihren Kenntnisstand und Ihre spezifische Unternehmenssituation eingehen. Aus diesem Grund möchten wir Sie bitten, die folgenden Fragen zu beantworten (Dauer ca. 5 Minuten). Ihre Angaben werden selbstverständlich vertraulich behandelt und unterliegen der beigefügten Datenschutzerklärung.

Für Ihre Zeit und Unterstützung möchten wir uns bereits vorab bei Ihnen bedanken.

Grundlegende Begriffe

Chatbots sind dialogbasierte Anwendungssysteme, welche die Ausführung von Aufgaben und Prozessen in intuitiver, natürlichsprachlicher – textueller oder audiobasierter – Art und Weise aus einem Chat heraus ermöglichen sollen. Aktuell bekannte Umsetzungen sind z. B. IKEA Anna, Apple Siri oder Amazon Alexa.

Digitale Büroarbeitsplätze stellen die Koordination zwischen (IT-)Technologien, Prozessen und Personen zur informationsbasierten Aufgabenerfüllung im Unternehmen dar. Der Fokus liegt auf der Arbeit mit Informationen und einer hohen Relevanz von Kommunikation unter den beteiligten Akteuren und Systemen.

Weiter

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Georg-August-Universität Göttingen

0% ausgefüllt

Figure 55 Appendix 3.1 – Pre-Questionnaire Page 1

[28] As the study was conducted in German, the original pre-questionnaire is shown in order not to falsify/change the questions/items through translation.

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Wirtschaftswissenschaftliche Fakultät
Professur für Anwendungssysteme und E-Business

Themenspezifische Fragen

1. Sind in Ihrem Unternehmen bereits Chatbots im Einsatz oder in der Erprobung (z. B. im Rahmen von Forschungs- bzw. Entwicklungsprojekten)?

- ◯ Ja.
- ◯ Nein, aber wir wollen uns in Zukunft damit befassen.
- ◯ Nein, Chatbots kommen für uns nicht in Frage.

2. In welchem Szenario eignet sich der Einsatz von Chatbots eher?

Bewerten Sie, ob sich der Einsatz von Chatbots eher in externen (an der Kundenschnittstelle) oder in internen (für Mitarbeiter) Einsatzszenarien eignet?

Extern	**Intern**
z. B. Beantworten von Kundenfragen, FAQs, Kunden-Selfservice, Kundensupport	z. B. Mitarbeiter-Selfservice, Helpdesk, Terminvereinbarung, Unternehmensprozesse

3. Wo sehen Sie Einsatzmöglichkeiten für Chatbots am digitalen Büroarbeitsplatz?

Sollten Sie noch keinen Einsatz planen oder Chatbots für Ihren Fall nicht in Frage kommen, geben Sie bitte eine Antwort zu potentiellen Einsatzmöglichkeiten.

(Mehrfachauswahl möglich)

- ☐ Informationsbeschaffung und -suche – z. B. FAQs, Suche nach Produkten, Termine, Wetter
- ☐ Abbilden von Standardprozessen – z. B. Self-Service, Terminvereinbarung, Banking, Einkaufen
- ☐ Erfassen von Daten – z. B. Bewerberpersonalien für eine Vorauswahl
- ☐ Aus- und Weiterbildung von Mitarbeitern – z. B. adaptiver Tutor, Vermitteln von Lerninhalten, Erfassen des Lernfortschrittes
- ☐ Dialogbasierte Benutzungsoberfläche für (Unternehmens-)Anwendungen und Services
- ☐ Weitere:

4. Welches sind die Ziele, die Sie mit dem Chatboteinsatz verfolgt haben oder verfolgen und wie konnten die Ziele erreicht werden?

Wenn Sie aktuell nur einen Einsatz planen, beantworten Sie bitte nur die Ziele.

(Mehrfachauswahl möglich)

	Ziel			
Ziele des Einsatzes	nicht erreicht	noch nicht erreicht	wurde erreicht	keine Angabe
☐ Steigern von Effizienz und Produktivität	◯	◯	◯	◯
☐ Verringern von Zeitaufwänden	◯	◯	◯	◯
☐ Reduzieren von Kosten	◯	◯	◯	◯
☐ Entlasten von Mitarbeitern durch übernehmen/automatisieren von Aufgaben	◯	◯	◯	◯
☐ Integrieren von (Unternehmens-)Anwendungen und Services in einem natürlichsprachlichen Dialog	◯	◯	◯	◯
☐ Endgeräteunabhängiger, mobiler Zugriff auf Anwendungssysteme	◯	◯	◯	◯
☐ Weitere:	◯	◯	◯	◯

5. Was sind die wichtigsten Eigenschaften bzw. Charakteristika eines Chatbots?

Beschreiben Sie einen Chatbot mit drei Wörtern.

1.
2.
3.

Zurück Weiter

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25% ausgefüllt

Figure 56 Appendix 3.1 – Pre-Questionnaire Page 2

GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

Wirtschaftswissenschaftliche Fakultät
Professur für Anwendungssysteme und E-Business

Unternehmensbezogene Daten

6. In welcher Branche ist Ihr Unternehmen primär tätig?

- ◯ Finanzen & Versicherungen
- ◯ Chemie, Pharma & Rohstoffe
- ◯ Fahrzeugbau
- ◯ Informations- & Kommunikationstechnik
- ◯ Maschinen- & Anlagenbau
- ◯ Sonstiges verarbeitendes Gewerbe
- ◯ Sonstige Dienstleistungen
- ◯ Keine Angabe

7. Wie viele Mitarbeiter beschäftigt ihr Unternehmen?

- ◯ Weniger als 50
- ◯ 51 bis 250
- ◯ 251 bis 500
- ◯ 501 bis 1.000
- ◯ 1.001 bis 5.000
- ◯ 5.001 bis 10.000
- ◯ 10.001 bis 50.000
- ◯ 50.001 bis 100.000
- ◯ Mehr als 100.000
- ◯ Keine Angabe

Personenbezogene Daten

8. In welcher Abteilung sind Sie tätig?

9. Welche Position bekleiden Sie?

10. Wie lange sind Sie in dieser Position tätig?

Jahre (z. B. 4 oder 5-6)

11. Wie alt sind Sie?

- ◯ 18-25
- ◯ 26-35
- ◯ 36-45
- ◯ 46-55
- ◯ 56-65
- ◯ 66 oder älter
- ◯ Keine Angabe

Zurück Weiter

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50% ausgefüllt

Figure 57 Appendix 3.1 – Pre-Questionnaire Page 3

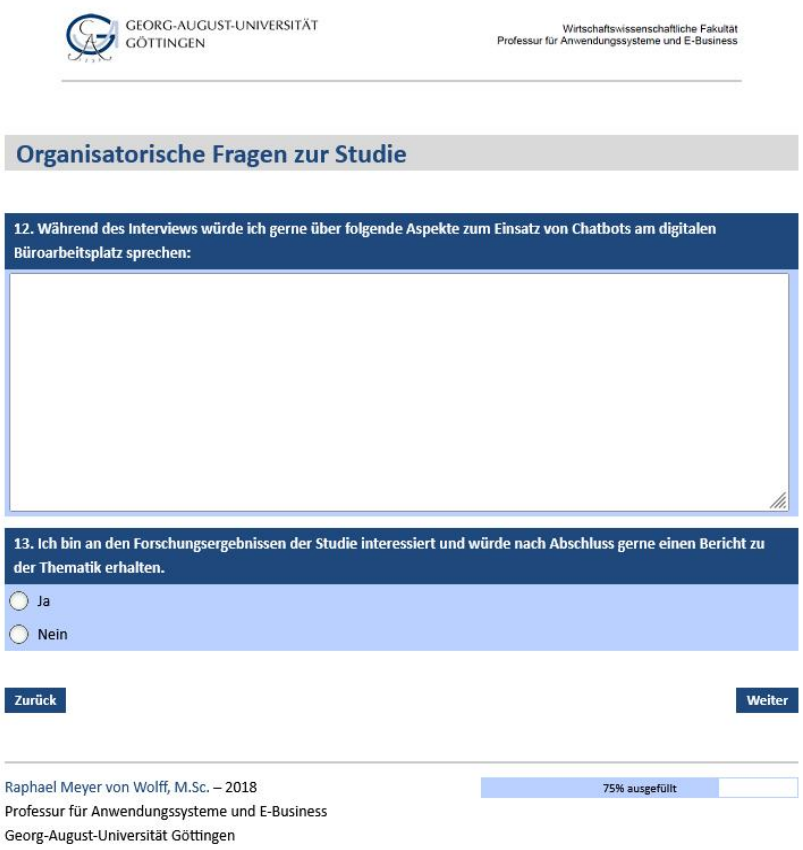

Figure 58 Appendix 3.1 – Pre-Questionnaire - Page 4

A3.2 Structured Interview Guideline[29]

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Professur für Anwendungssysteme und E-Business
Prof. Dr. Matthias Schumann

INTERVIEWLEITFADEN

zur qualitativ-empirischen Untersuchung zum Einsatz von Chatbots am digitalen Büroarbeitsplatz in Unternehmen.

ZIEL DER INTERVIEWS

- Einsatzmöglichkeiten an Chatbots am digitalen Büroarbeitsplatz identifizieren:
  - Aktuelle, geplante und zukünftige Nutzung
  - Anforderungen in den Bereichen Sachaufgaben und Informationsbeschaffung
- Wirkungen bzw. geplante Ziele des Einsatzes ermitteln
- Rahmenbedingungen des Einsatzes untersuchen
  - Herausforderungen, Grenzen und Probleme bei Einführung und Betrieb
  - Lösungsansätze
- Möglichkeiten und Mehrwert von Chatbots

ZIELGRUPPE

Domänenexperten und Unternehmensvertreter,

- die über Kenntnisse …
  - … zu aktuellen Themen der Digitalisierung;
  - … zu digitalen Assistenzsysteme; insbesondere Chatbots;
  - … zur zukünftigen Büroarbeitsplatzgestaltung verfügen.
- die idealerweise erste Erfahrungen mit dem Einsatz von Chatbots am (digitalen) Büroarbeitsplatz haben.

VORGEHEN

- Halbstrukturiert
- Leitfadengestützt

AUFBAU DES INTERVIEWLEITFADENS

Teil 1: Gesprächseinstieg
Teil 2: Einsatzgebiete von Chatbots
  a. Bisheriger und zukünftiger Einsatz von Chatbots
  b. Potentieller Einsatz oder kein Einsatz von Chatbots
Teil 3: Rahmenbedingungen des Einsatzes
Teil 4: Diskussion
Teil 5: Gesprächsabschluss

1

Figure 59 Appendix 3.2 – Structured Interview Guideline - Page 1

[29] As the study was conducted in German, the original guideline is shown in order not to distort/change the statements/questions through translation.

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TEIL 1: GESPRÄCHSEINSTIEG

Begrüßung und Vorstellung

- Begrüßung der Interviewteilnehmer und Danksagung für die Bereitschaft zur Teilnahme
  [Einleitung:] *Sehr geehrter Herr / Frau [TeilnehmerIn]. Danke, dass wir die Möglichkeit haben uns mit Ihnen zum Einsatz von Chatbots am digitalen Büroarbeitsplatz in Ihrem Unternehmen zu unterhalten.*
- Kurzvorstellung der Interviewer
- Bitte um kurze Vorstellung der/des Interviewpartner(s)

Einführung in das Forschungsvorhaben

- Vorstellung der Inhalte und Zielsetzungen des Forschungsvorhabens
- Kurze Erklärung zu den Begriffen Chatbots sowie digitaler Büroarbeitsplatz
  - Gibt es Ihrerseits noch offene Fragen / Unklarheiten zu den Forschungsdomänen?

Klärung formaler Rahmenbedingungen

- Datenschutz und Einverständnis zur Aufzeichnung
  - Selbstverständlich werden die in diesem Interview gemachten Angaben von uns vertraulich behandelt und unterliegen der vorliegenden Datenschutzerklärung
  - Zu Auswertungszwecken würden wir das Interview gerne aufzeichnen. Die Audioaufnahme wird im Anschluss transkribiert und anonymisiert, sodass keinerlei Rückschlüsse auf Sie oder Ihr Unternehmen möglich sind. Die Auswertung der Interviews erfolgt auf Grundlage dieser anonymisierten Abschriften für wissenschaftliche Zwecke.
    [Falls noch nicht vorliegend, Datenschutz- und Einwilligungserklärung einholen]

- Interviewablauf
  - Das Interview wird etwa 45 Minuten (max. 60 Minuten) in Anspruch nehmen. Es basiert auf einem variablen Fragenkatalog. Sie können gerne jederzeit eigene Fragen oder Anmerkungen einfließen lassen.
  - Haben Sie bis hierhin Fragen zum Inhalt oder Ablauf des Interviews?

[Falls Einverständnis zur Aufzeichnung; Tonaufnahme starten!]

Figure 60 Appendix 3.2 – Structured Interview Guideline - Page 2

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Professur für Anwendungssysteme und E-Business
Prof. Dr. Matthias Schumann

TEIL 2: EINSATZGEBIETE VON CHATBOTS

[Einleitung:] *Das zentrale Interesse des Forschungsvorhabens liegt in dem Einsatz von Chatbots für Standardprozesse bzw. Sachaufgaben und Unterstützungstätigkeiten des digitalen Büroarbeitsplatzes.*

Fragen zu Einsatzgebieten von Chatbots am digitalen Büroarbeitsplatz:

- Sind in Ihrem Unternehmen bereits Chatbots im Einsatz oder in der Erprobung (z. B. im Rahmen von Forschungs- bzw. Entwicklungsprojekten)?

  Wenn Ja (Gruppe A):

  ⇨ TEIL 2A-1: Einsatzgebiete und bisherige Nutzung von Chatbots *(Seite 4)*
  ⇨ TEIL 2A-2: Zukünftige und weitere Einsatzgebiete von Chatbots *(Seite 5)*

  Wenn Nein (Gruppe B):

  ⇨ TEIL 2B: Potentielle Einsatzgebiete und Erwartungen an Chatbots *(Seite 6)*

Figure 61 Appendix 3.2 – Structured Interview Guideline - Page 3

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TEIL 2A-1: AKTUELLE EINSATZGEBIETE VON CHATBOTS

Fragen zu aktuellen Einsatzgebieten von Chatbots am digitalen Büroarbeitsplatz:

- Für welche Tätigkeiten und Aufgaben werden Chatbots in Ihrem Unternehmen am digitalen Büroarbeitsplatz eingesetzt?
- Welche Aufgaben oder Tätigkeitsbereiche werden durch Chatbots unterstützt?

  [mögliche Detailfragen – je nach Gesprächsverlauf]

- Welche Zielsetzung wurde mit dem Einsatz verfolgt?
- Aus welchen Gründen haben Sie sich für den Einsatz von Chatbots entschieden?

- Was zeichnet Aufgaben für einen Chatbot aus?
- Welche Mitarbeiter nutzen die Chatbots?
- Welche Anforderungen haben Sie für die Einsatzgebiete an einen Chatbot?
- Welche drei Anforderungen sollte ein guter Chatbot für den Büroarbeitsplatz besitzen? Beschreiben Sie einen Chatbot mit drei Wörtern!

- Welcher Nutzen ergibt sich aus dem Einsatz für Ihr Unternehmen?
- Welche Auswirkungen hat der Einsatz auf die unterstützten Prozesse oder Tätigkeiten (bspw. hinsichtlich der Abläufe, Arbeitsweisen, Schnittstellen, Akteure)?

- Wer trug die Initiative bei dem Vorhaben (z. B. Geschäftsführung, CxO, IT-Abteilung, Mitarbeiter)?
- Wurden extra Verantwortliche/Abteilungen eingeführt oder wurden die Projekte aus bestehenden Strukturen organisiert? Wenn ja, welche?
- Wer ist für die Wartung und Pflege verantwortlich?
- Wie regelmäßig wird Feedback / werden Änderungen eingepflegt und der Chatbot aktualisiert?

- Wie sind die Chatbots bei Ihnen technisch umgesetzt?
  - Wie wurden die Chatbots entwickelt?
    - Frameworks? (IBM Watson, API.ai, Microsoft Bot Framework, etc.)
    - Mit Hilfe einer Plattform ? (Chatfuel, etc.)
  - Wie können die Chatbots genutzt werden? Wie bzw. wo sind sie eingebunden? Mobil, Desktop, Webseite?
  - Aus welchen Systemen kann der Chatbot genutzt werden? Ist es ein eigenes System oder eingebunden?
  - Welche Schnittstellen nutzt der Chatbot? Auf welche Unternehmensanwendungen und Datenbanken kann zugegriffen werden?

Figure 62 Appendix 3.2 – Structured Interview Guideline - Page 4

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TEIL 2A-2: ZUKÜNFTIGE UND WEITERE EINSATZGEBIETE VON CHATBOTS

[Einleitung:] *Nachdem wir gerade über Ihre Einsatzszenarien gesprochen haben, wollen wir noch kurz auf zukünftige, weitere Vorhaben eingehen.*

Fragen zu weiteren – bisher noch nicht erprobten bzw. genutzten – Einsatzgebieten von Chatbots am digitalen Büroarbeitsplatz:

- Soll der bisherige Einsatz ausgeweitet werden? Wo sehen sie noch weitere Einsatzmöglichkeiten? Was soll in Zukunft unterstützt werden?
- Wie soll der Einsatz von Chatbots zukünftig ausgestaltet sein?
- Gibt es noch weitere Einsatzgebiete von Chatbots in Ihrem Unternehmen bzw. Ihrer Branche?

  [mögliche Detailfragen – je nach Gesprächsverlauf Seite 4]

- *Können Sie sich weitere Einsatzgebiete für andere Arbeitsplätze oder Branchen vorstellen, in denen Chatbots einen Mehrwert bieten können?*

  [mögliche Detailfragen – je nach Gesprächsverlauf Seite 4]

- Können sie Einsatzgebiete ausschließen, die nicht durch Chatbots übernommen werden können, wenn ja warum? Was zeichnet diese Einsatzgebiete aus?

Figure 63 Appendix 3.2 – Structured Interview Guideline - Page 5

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TEIL 2B: POTENTIELLE EINSATZGEBIETE UND ERWARTUNGEN AN CHATBOTS

Fragen zu potentiellen Einsatzgebieten von Chatbots am digitalen Büroarbeitsplatz und Gründen gegen eine Einführung:

- Haben Sie vor sich mit dem Einsatz von Chatbots zu befassen? Oder kommt es in Ihrem Fall nicht in Frage?

Wenn ja:

- Für welche Tätigkeiten und Aufgaben sollen Chatbots in Ihrem Unternehmen am digitalen Büroarbeitsplatz eingesetzt werden?
- Welche Aufgaben oder Tätigkeitsbereiche sollen durch Chatbots unterstützt werden?

  [mögliche Detailfragen – je nach Gesprächsverlauf]

- Was zeichnet Aufgaben für einen Chatbot aus?
- Welche Tätigkeiten könnten Sie sich vorstellen, die ein Chatbot übernehmen kann?

- Welche Erwartungen haben Sie an Chatbots für den Einsatz am Büroarbeitsplatz?
- Was muss ein Chatbot können/leisten, um eingesetzt zu werden?
- Welche Anforderungen zeichnen einen guten Chatbot für Sie aus?

- Wer trägt die Initiative bei den Planungen (z. B. Geschäftsführung, CxO, IT-Abteilung, Mitarbeiter)? Wer verwaltet / überwacht die Planungen?
- Werden / wurden hierfür Verantwortliche / Abteilungen geschaffen oder werden die Projekte aus bestehenden Strukturen organisiert? Wenn ja, welche?

- Aus welchen Gründen beschäftigen Sie sich erst jetzt mit konkreten Einsatzszenarien?
- Was sprach bisher gegen einen Einsatz von Chatbots?
- Was hat die Einführung von Chatbots bisher verhindert?

Wenn nein:

- Wurde ein Einsatz innerhalb Ihres Unternehmens diskutiert?
- Was spricht gegen einen Einsatz von Chatbots in Ihrem Unternehmen?
- Sehen Sie Einsatzmöglichkeiten für andere Bereiche / Branchen wo ein Chatbot unterstützen könnte?
- Wo wünschen Sie sich allgemein Unterstützung in der Büroarbeit? Wo sehen sie Entlastungspotential durch Assistenzsysteme?

Figure 64 Appendix 3.2 – Structured Interview Guideline - Page 6

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TEIL 3: RAHMENBEDINGUNGEN DES EINSATZES

[Einleitung:] *Nachdem wir gerade über Einsatzgebiete gesprochen haben, möchte ich gerne noch auf die Rahmenbedingungen – sowohl Hindernisse und Grenzen als auch Herausforderungen und Lösungsansätze – beim Einsatz von Chatbots im digitalen Büroarbeitsplatz eingehen.*

Fragen zu Hindernissen oder Grenzen *(Nur Gruppe A)*:

- Auf welche Hindernisse oder Grenzen sind Sie bei der Einführung gestoßen?
- Auf welche Hindernisse oder Grenzen sind Sie bei der Nutzung im laufenden Betrieb gestoßen?
- Gibt es Einsatzmöglichkeiten, die mit aktuellen Lösungen nicht „zufriedenstellend" adressiert werden?
- Was funktioniert gut, schlecht, nicht mit Chatbots? Gibt es Funktionen von Chatbots die nicht funktionieren?
- Welche sonstigen Faktoren oder Rahmenbedingungen mussten bei der Einführung / Nutzung von Chatbots berücksichtigt werden?

Fragen zu Herausforderungen und Lösungsansätze (alle Gruppen):

- Welche Herausforderungen oder Probleme sehen Sie beim Einsatz von Chatbots aktuell bzw. zukünftig am digitalen Büroarbeitsplatz?
  [Sofern keine Aussagen / Ideen durch den Interviewpartner gebracht werden, beispielhafte Herausforderungen nennen und beurteilen lassen]
  - Technisch (z. B. Funktionen, Pflege der Datenbasis, Schnittstellen);
  - Organisatorisch (z. B. Nutzen der Technologie, Unterstützung durch Management, tatsächliche Verwendung)
  - Umwelt (z. B. Gesetze, Betriebsvereinbarungen, Datenschutz)
- Bewertung von Herausforderungen:
  - Wie kritisch sehen Sie die von Ihnen genannten Herausforderungen? Was sind ggf. die kritischsten Herausforderungen?
  - Was sind unkritische Herausforderungen? Warum sind diese Herausforderungen unkritisch?
- Wie wird den Herausforderungen in Ihrem Unternehmen begegnet bzw. welche Lösungsansätze sind aus Ihrer Sicht möglich?
  [Aufgreifen der vorher genannten Herausforderungen]

Figure 65 Appendix 3.2 – Structured Interview Guideline - Page 7

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TEIL 4: DISKUSSION

[Einleitung:] *Zum Abschluss des Gesprächs würde ich gerne noch kurz ihre persönliche Meinung zu Chatbots am digitalen Büroarbeitsplatz erfahren.*

Einleitende Fragen zur Diskussion (alle Gruppen):

- Welche neuen Möglichkeiten ergeben sich durch den Einsatz von Chatbots am digitalen Büroarbeitsplatz?
  [Sofern keine Aussagen durch den Interviewpartner hervorgebracht werden, nennen von Potentialen und bewerten lassen], z. B.:
  - Dialogbasiertes ausführen von Systemen, Prozessen
  - Integration von bestehenden Anwendungssystemen
  - Entlastung durch Automatisierung

- Wie würden Sie Chatbots im Vergleich zu bestehenden Anwendungssystemen am Büroarbeitsplatz bewerten? Bieten Chatbots einen Mehrwert?
  - Wenn **Ja**:
    - Welchen?
    - Denken Sie, dass sich Chatbots für den Büroarbeitsplatz durchsetzen?
  - Wenn **Nein**:
    - Warum kein Nutzen?
    - Was können Chatbots schlechter?
    - Was können die bestehenden Systeme besser?

- Haben / Nutzen Sie selber in ihrem Alltag Chatbots? Wären Sie persönlich bereit Chatbots (in Ihrem Unternehmen) zu verwenden?

- Gibt es andere Assistenzsysteme bei Ihnen im Einsatz, die nicht über eine natürlichsprachliche Benutzungsschnittstelle verfügen?

- Was denken Sie, wie wird sich der Büroarbeitsplatz in Zukunft weiter verändern?

Figure 66 Appendix 3.2 – Structured Interview Guideline - Page 8

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TEIL 5: GESPRÄCHSABSCHLUSS

[Einleitung:] *Vielen Dank für die Möglichkeit Sie zum Einsatz von Chatbots am digitalen Büroarbeitsplatz zu befragen. Wir haben hiermit das Ende des Interviews erreicht.*

Abschließende Anmerkungen:

- Gibt es abschließend etwas, was Sie gerne noch ansprechen möchten?

[Tonaufnahme beenden!]

- Da wir auch gerne die Seite der zukünftigen/tatsächlichen Nutzer untersuchen würden, haben Sie vielleicht Ansprechpartner in Ihrem Unternehmen die wir dazu gesondert befragen können?

- Haben Sie weiterhin Interesse am Forschungsgebiet Chatbots sowie den daraus resultierenden Ergebnissen? Wenn ja, würden wir Sie gerne ggf. im Rahmen weiterer Forschungsvorhaben nochmals kontaktieren.

Danksagung und Verabschiedung

Figure 67 Appendix 3.2 – Structured Interview Guideline - Page 9

A3.3 Classification Matrix of the Interviews

				Interview		Int01	Int02	Int03	Int04	Int05	Int06	Int07	Int08	Int09	Int10	Int11	Int12	Int13	Int14	Int15	Int16	Int17	Int18	Int19	Int20	Int21	Int22	Int23	Int24	Int25	Int26	Int27
Influencing Factors and Challenges	Environmental	Competitive Situation	F_E3	Dependencies on the provider of chatbot technology	$C_E3.2$						–	–			–			–					–									
				Innovation pressure to use chatbots	$C_E3.1$				–		–			–	–	–				–		–		–				–		–		–	–
		Law Situation	F_E2	Ensuring data security	$C_E2.2$			–	–		–				–			–	–		–	–			–							–
				Ensuring data protection (concerning GDPR)	$C_E2.1$	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
		Customer Situation	F_E1	Impersonal customer contact	$C_E1.2$											–		–			–											
				Loss of customers	$C_E1.1$						–							–		–													
	Individual	Management	F_I2	Loss of management support during the project	$C_I2.2$													–		–			–									
				Misjudgment of the effort of chatbot projects	$C_I2.1$	–									–					–													
		Employees	F_I1	Dissatisfaction due to lack of assistance	$C_I1.7$			–	–	–		–	–				–	–	–	–													
				Irritation when not recognizing chatbots immediately	$C_I1.6$		–					–						–		–							–						
				Adapt to the syntax and the dialog structure	$C_I1.5$			–			–			–	–					–	–		–										
				Lack of experience with chatbots or the technology behind	$C_I1.4$	–				–								–				–		–				–			–	–
				Fear of job loss	$C_I1.3$		–				–		–	–									–			–	–		–	–	–		
				Acceptance problems of users for chatbots	$C_I1.2$	–	–	–			–	–		–	–	–	–	–	–	–	–	–	–		–		–	–	–		–	–
				Overestimation and high expectations of employees	$C_I1.1$			–		–	–		–	–	–	–	–	–			–					–		–	–	–	–	–
	Organizational	Operation	F_O2	Risk of know-how loss in the company	$C_O2.3$						–																					
				Missing responsibilities for chatbots	$C_O2.2$													–				–		–									
				Extensive maintenance and continuous training of chatbots in the company	$C_O2.1$	–	–	–	–	–	–	–	–			–	–	–	–	–	–	–	–	–	–	–	–	–					
		Introduction	F_O1	Obstacles by the works council	$C_O1.8$									–						–	–		–		–	–	–	–		–	–	
				Generation of content for chatbots from the different departments	$C_O1.7$								–				–	–															
				Creating chatbots is time-consuming and cost-intensive	$C_O1.6$		–	–	–	–	–			–	–	–	–	–		–							–		–			–	
				Scalability of chatbots	$C_O1.5$									–	–				–	–								–	–				
				Existing (business processes) processes cannot be mapped by chatbots	$C_O1.4$				–													–											
				Definition and design of use cases	$C_O1.3$		–	–		–	–		–	–	–		–	–	–	–					–	–	–		–				–
				Missing of an added-value	$C_O1.2$			–			–	–	–	–	–	–	–	–	–		–	–		–		–	–		–				–
				Lack of an agenda for chatbots	$C_O1.1$														–								–		–		–	–
	Technological	Chatbots' User Interface	F_T4	Restrictions and limitations within the user interface	$C_T4.2$					–			–	–			–		–	–		–				–						–
				Inappropriate tools for creating and maintaining chatbots	$C_T4.1$					–			–																				
		Integrated System Landscape	F_T3	Integration into user interfaces of existing information systems and/or interfaces	$C_T3.2$			–		–								–						–	–							
				Data and process integration with existing information systems and/or databases	$C_T3.1$		–		–					–	–			–	–	–					–	–		–			–		–
		Functional Scope	F_T2	Problems with language understanding and effort for language localization	$C_T2.4$	–			–	–			–	–	–				–	–							–	–	–				
				Preserving the conversation context in the conversation process	$C_T2.3$							–	–	–	–											–							
				Mapping of dynamic, volatile processes or conversations	$C_T2.2$							–		–	–	–	–						–	–						–			
				All (conversation-)paths must be defined in advance	$C_T2.1$	–													–					–			–						
		Data Management	F_T1	The coherence of the statements of a chatbot and real (service) employee	$C_T1.2$																									–			
				Provision and maintenance of the required (knowledge) database	$C_T1.1$		–	–			–	–			–	–	–	–	–		–					–	–	–	–		–	–
Objectives		Indirect		Reduce Costs	O_{15}	–	–	–			–		–	–	–		–	–				–	–	–	–	–	–	–		–	–
				Increase Productivity and Efficiency	O_{14}					–				–	–	–	–	–	–	–		–	–		–	–	–					
				Improve Service Quality	O_{13}											–												–				
				Improve the Quality of Work	O_{12}											–	–					–		–	–	–	–	–	–	–	–	–
				Strengthen Innovation and Image	O_{11}											–		–						–	–							
		Mid-level		Reduce Time Expenditure	O_{10}		–	–	–	–	–	–		–		–	–	–		–	–	–		–	–	–			–	–	–	–
				Support Employees	O_9	–		–			–		–		–		–		–		–					–			–	–		
				Relieve the Workload of Employees	O_8	–		–	–	–		–	–	–	–	–	–	–		–	–	–		–					–	–	–	–
				Adaptation to the Individual User	O_7	–							–					–		–	–		–		–	–	–		–	–		–
				Reduce Work and System Landscape Complexity	O_6	–																					–		–				
				Enhance and Standardize Processes and Procedures	O_5		–		–			–		–				–		–						–		–		–		
				Modernization and Digitalization of Work	O_4	–	–	–	–			–		–			–			–	–	–		–	–					–	–	
		Direct		24/7 Availability	O_3		–		–			–	–			–		–		–			–					–	–		–
				Automation of Tasks and/or Processes	O_2			–	–		–		–	–	–		–	–		–		–			–		–	–	–			
				Single Platform to all Systems and Data Sources	O_1	–			–			–		–			–	–		–	–	–	–		–	–	–	–	–				–
Application Area		Cross-Divisional		Knowledge and information management	A_7		–		–			–				–	–		–		–			–		–		–			–
				Education and training	A_6		–						–								–				–			–	–			–
				(Employee) Self-service	A_5	–	–				–	–	–	–	–	–	–	–		–		–	–	–	–	–		–	–	–	–	–
		Divisional		Maintenance	A_4																–						–					
				Purchase and sales	A_3	–	–			–				–	–					–	–				–				–				
				Human resources	A_2	–	–		–	–																							
				Support (internal/external)	A_1	–	–	–	–	–	–	–	–	–	–		–	–	–			–	–	–	–		–	–	–		–	–
Chatbot Usage		Information Provision	U_3	Reminders																–						–					
				Provide Files/ or Documents or Links			–							–	–		–	–							–								–
				Dynamic, Unstructured Information		–			–			–				–	–		–		–		–	–	–	–							–
				Static, Predefined Information		–	–	–	–	–	–	–	–	–	–		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
		Process Guidance and Execution	U_2	Rule-based; Multiple Actors		–	–										–			–		–							–		–	
				Standardized; Single Actors		–		–				–	–	–			–	–	–	–	–							–	–	–	–	–	–
		Information Capture	U_1	Unstructured Input							–	–				–				–				–				–		–		
				Structured Input						–				–	–		–	–	–		–		–			–	–			–	–	

Figure 68 Appendix 3.3 – Classification Matrix of the Interviews

A3.4 Exemplary Quotes for Influencing Factors and Challenges[30]

Technological Influencing Factors

F_T1	**Data management**
Quotes	"*This has an impact on the training of a chatbot, the continuous data maintenance, which becomes incredibly comprehensive the bigger this chatbot gets.*" (EXP03) "*The aim is to make data available and above all to make data available in a standardized way, which would be the technological challenge [...].*" (EXP25) "*[...] the topic concerning employees and customers, the topic coherence of knowledge, so what I ask the employee and what the chatbot tells me, must also fit together.*" (EXP27)
Challenges	
$C_T1.1$	Provision and maintenance of the required (knowledge) database
$C_T1.2$	The coherence of the statements of a chatbot and real (service) employee

F_T2	**Functional scope**
Quotes	"*[...] you have to define it beforehand anyway, [...] if you don't define it beforehand - as the one who sets up this artificial intelligence - [...] he doesn't [...] do it and that's why it's always scripted for me in the end [...].*" (Exp14) "*[...] the difficulty is to achieve a real dynamic, natural conversation. This applies not only to normal conversations but also to all processes that can be mapped. You can only really represent a certain range of dynamics.*" (Exp10) "*Chatbots have difficulties creating a conversation context to the things we said a few sentences ago.*" (Exp22) "*The transformation of what I said and recognizing from it what I actually want is the really hard nut to crack and there are still challenges.*" (Exp09)
Challenges	
$C_T2.1$	All (conversation-)paths must be defined in advance
$C_T2.2$	Mapping of dynamic, volatile processes or conversations
$C_T2.3$	Preserving the conversation context in the conversation process
$C_T2.4$	Problems with language understanding and effort for language localization

F_T3	**Integrated system landscape**
Quotes	"*We used existing interfaces, but always the interfaces have to be made new and they have to be maintained. Well, that's already the case if you go deep into the company systems, then that's already a lot of adjustment effort within the company IT.*" (EXP02) "*You had asked us perhaps to do something via existing chat programs, [...] that we can communicate with our Skype or Jabber directly with the chatbot here, I don't see that yet.*" (EXP13)
Challenges	
$C_T3.1$	Data and process integration with existing information systems and/or databases
$C_T3.2$	Integration into user interfaces of existing information systems and/or interfaces

F_T4	**Chatbot's user interface**
Quotes	"*Such environments are still missing from my point of view in today's chatbot products, that I have the possibility [to define responsibilities and tasks; ...], so that also the professional user can bring his knowledge into this bot. But this frontend for a professional process to define chat content separates the solutions.*" (EXP08) "*In my opinion, the dialog interface of a chatbot is simply too limited to this simple, one-dimensional and above all [...] synchronized input/output interaction for more complex processes. [...] no matter how clever the chatbot is in the background, this is the basic logic of the interface [...]*" (EXP09)
Challenges	
$C_T4.1$	Inappropriate tools for creating and maintaining chatbots
$C_T4.2$	Restrictions and limitations within the user interface

Table 49 Appendix 3.4 – Exemplary Quotes for Technological Influencing Factors

[30] Quotes translated from German.

Organizational Influencing Factors

F_O1	Introduction
Quotes	"*[...] it just has something to do with the company here. The corporate strategy has not yet planned to invest heavily in this area.*" (EXP28) "*[...] the accessibility to the general public, there is still a lot of potential there, so that the potential [...] is also recognized. [...] This is the core task of everyone who is currently dealing with [chatbots] to tell us what the added value really is.*" (EXP18) "*The most critical challenge for me is actually the use case. If this is not clear, then the project will fail and the use case is always dependent on whether the data and systems I need to map the use case are available. [...] there are use cases, which I can map much faster via a graphical interface [...] But there will be use cases, where I am inhibited by [...] a real UI.*" (EXP02) "*We've already tried that, [...] maybe we can use the badly designed process we currently have to map automation so that we can get faster. No, it doesn't work.*" (EXP04) "*A very important point is if I have enough chat traffic. Of course, I have to count against, if I have a [use case] that justifies it. I must have [...] enough requests where I say I could automate 80 percent of them.*" (EXP15) "*But I don't think we're ready for chatbots yet. I think there is a lot of custom development, a lot of customizing, a lot of setup and personalization […] and I don't think that's worth it internally for a company our size.*" (EXP09) "*When you talk to an internal help desk, you actually need to talk to the people you are planning to replace in order to define the content you want to teach the chatbot. [...] a lot of the project effort goes into pulling the knowledge out of the departments, preparing it and paste it into the chatbot.*" (EXP08) "*The works council has become more alert about this. Because I once mentioned that it's nice when the chatbot knows a lot about the employee and he has a lot of information. Of course, you can also link a lot.*" (EXP09)
Challenges	
$C_O1.1$	Lack of an agenda for chatbots
$C_O1.2$	Missing of an added-value
$C_O1.3$	Definition and design of use cases
$C_O1.4$	Existing (business processes) processes cannot be mapped by chatbots
$C_O1.5$	Scalability of chatbots
$C_O1.6$	Creating chatbots is time-consuming and cost-intensive
$C_O1.7$	Generation of content for chatbots from the different departments
$C_O1.8$	Obstacles by the works council
F_O2	Operation
Quotes	"*One of the first challenges is the issue of training expenditure. […] if you put it into operation freshly, even with reasonable preparation of FAQ knowledge, it still does not understand numerous turns of our communication. This means that there is a large amount of effort in advance and a large amount during the operation.*" (EXP27) "*[...] who is responsible for the knowledge we have in there? If we give this to an external service provider, […] do we want to give them our knowledge about [company name]? Who is responsible for maintaining this knowledge? Who is responsible for ensuring that what's in there is still current?*" (EXP14) "*[...] if the employees have been assigned other tasks and the bot then no longer works. [...] danger that the abilities are lost because everyone only does complex things and has no idea about the simple bot tasks.*" (EXP06)
Challenges	
$C_O2.1$	Extensive maintenance and continuous training of chatbots in the company
$C_O2.2$	Missing responsibilities for chatbots
$C_O2.3$	Risk of know-how loss in the company

Table 50 Appendix 3.4 – Exemplary Quotes for Organizational Influencing Factors

Individual Influencing Factors

F_I1	**Employees**
Quotes	"*[…] a greater degree of expectation management is needed to bring technology closer to people. Because from radio and television advertising, expectations are relatively high.*" (EXP08) "*Another limitation is to actually use the inhibition threshold of the chatbot. If I've fallen into my typical work grid and I know exactly what I need to use, how it works, then I usually don't need chatbots. [...] That's why [...] employees who have been with the company for some time are rather skeptical about chatbots.*" (EXP12) "*You also see the enthusiasm for innovation as well as the concerns for an artificial intelligence dominated workplace. You quickly notice that [chatbots] are not only perceived as support, but also as a threat.*" (EXP19) "*[...] because it is a relatively new topic, the technical component is, of course, the first challenge, i.e. to familiarize oneself with what all these individual components can actually do and what they do exactly.*" (EXP29) "*I hardly use [Google Assistant] at all, [...] because I always have to think too much about how to formulate a question so that he understands it. So I can't just [talk to him; ...]. As long as I can't do that, [...] I can do it with the old IT system or call someone.*" (EXP09) "*It shouldn't go as far as Google [...] has done that you don't even realize anymore that this is a machine talking to you. That should still remain recognizable.*" (EXP07) "*As soon as you notice that the chatbot may not be able to help you, the acceptance of the product decreases. We have also made the experience.*" (EXP04)
Challenges	
$C_I1.1$	Overestimation and high expectations of employees
$C_I1.2$	Acceptance problems of users for chatbots
$C_I1.3$	Fear of job loss
$C_I1.4$	Lack of experience with chatbots or the technology behind
$C_I1.5$	Adapt to the syntax and the dialog structure
$C_I1.6$	Irritation when not recognizing chatbots immediately
$C_I1.7$	Dissatisfaction due to lack of assistance
F_I2	**Management**
Quotes	"*So with the projects I've been involved with so far, it was always assumed that we'd set this up and then it would work and then it'd be good. And that's a misjudgment.*" (EXP01) "*The management actually supports us by providing the budgets and formulating the desire to have them. But then it also retreats into the background.*" (EXP19)
Challenges	
$C_I2.1$	Misjudgment of the effort of chatbot projects
$C_I2.2$	Loss of management support during the project

Table 51 Appendix 3.4 – Exemplary Quotes for Individual Influencing Factors

Environmental Influencing Factors

F_E1 Customer situation	
Quotes	"*Risk of negative perception if the chatbot breaks down, as customer inquiries cannot be answered then.*" (EXP06) "*With the Bot, one would feel as a user also kidded, because someday one learns to know the borders and thinks, The company doesn't want to raise any costs for customer support and pay an employee.*" (EXP11) "*If an internal user who is chatting with us is dissatisfied with something, we might get a complaint. If an external customer [...] is dissatisfied with something, then he goes to the next one.*" (EXP13)
Challenges	
$C_E1.1$	Loss of customers
$C_E1.2$	Impersonal customer contact
F_E2 Law situation	
Quotes	"*[...] any data processing system, where an end-user has the possibility to capture free texts, simply holds the danger. Even if everything else is intercepted and made anonymous [...]. But wherever free texts are concerned [...] there is always the danger that they are abused [...]. If that's not allowed to happen, then I estimate it in such a way […], that it's only possible with great effort to largely prevent it.*" (EXP01) "*That my data is always spread, where does it end up, who can all listen, what can be done with it. [...] that is of course simply a risk [...]. Currently, I wouldn't think of any technology that could improve that, unless I keep everything here in the house. The question is can I go with this technological lead?*" (EXP16) "*So when we look at Germany, the very first thing that comes to my mind is data protection problems. The issue of data protection is extremely important in this area, at least to establish this issue in Germany.*" (Exp25)
Challenges	
$C_E2.1$	Ensuring data protection (with regard to the general data protection regulation (GDPR))
$C_E2.2$	Ensuring data security
F_E3 Competitive situation	
Quotes	"*Management says, "I want to have, you have to have these days, everyone has one." [...] and then you have a solution with which everyone is dissatisfied afterward. [...] "Everyone has a chatbot, we need one too!" Really complete without Use Case behind it.*" (EXP16) "*Because it is not so much about what is currently possible, but much more about the question of who can develop further and how quickly. [...] So it's much more about the question who I think will be the best than the question who is currently the best. And that applies both to speech recognition and to the dialog control.*" (EXP19)
Challenges	
$C_E3.1$	Innovation pressure to use chatbots
$C_E3.2$	Dependencies on the provider of chatbot technology

Table 52 Appendix 3.4 – Exemplary Quotes for Environmental Influencing Factors

A4 Requirements Analysis for Information Acquisition Chatbots[31]

GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

Wirtschaftswissenschaftliche Fakultät
Professur für Anwendungssysteme und E-Business

Chatbots für die Informationsbeschaffung im universitären Kontext

Fragebogen zur qualitativen Untersuchung

Liebe Teilnehmende, Lieber Teilnehmender,

mit dieser Befragung wollen wir einen Überblick über die erforderlichen Themengebiete, Fragen und Eigenschaften bekommen, die ein Chatbot zur Beantwortung von Fragen im universitären Kontext beherrschen sollte. Die Bearbeitungsdauer des Fragebogens beträgt ca. **5 - 10 Minuten**. Beantworte die Fragen bitte gewissenhaft und nach Deinem eigenen Ermessen.

Deine Angaben werden selbstverständlich vertraulich behandelt und anonymisiert erfasst.

Unter sallen Teilnehmenden verlosen wir **100 Gutscheine für ein Heißgetränk** (Kaffee, Tee, Kakao) im Café Campus. Nähere Informationen hierzu findest Du am Ende des Fragebogens.

Für Deine Zeit und Deine Unterstützung möchten wir uns im Voraus bedanken.

Mit besten Grüßen

Jonas Nörtemann und Raphael Meyer von Wolff

Definition Chatbot

Ein **Chatbot** ist eine neue Form der Benutzungsoberfläche, durch die ein Mensch ein Anwendungssystem natürlichsprachlich steuern kann. Die Interaktion kann dabei über Texteingaben oder Sprache erfolgen. D.h. Chatbots können bspw. auf Fragen antworten. Dafür nutzen sie künstliche Intelligenz in verschiedenen Ausprägungen. Die wohl bekanntesten Beispiele für Chatbots sind Amazon Alexa, Apple Siri oder auch Google Home.

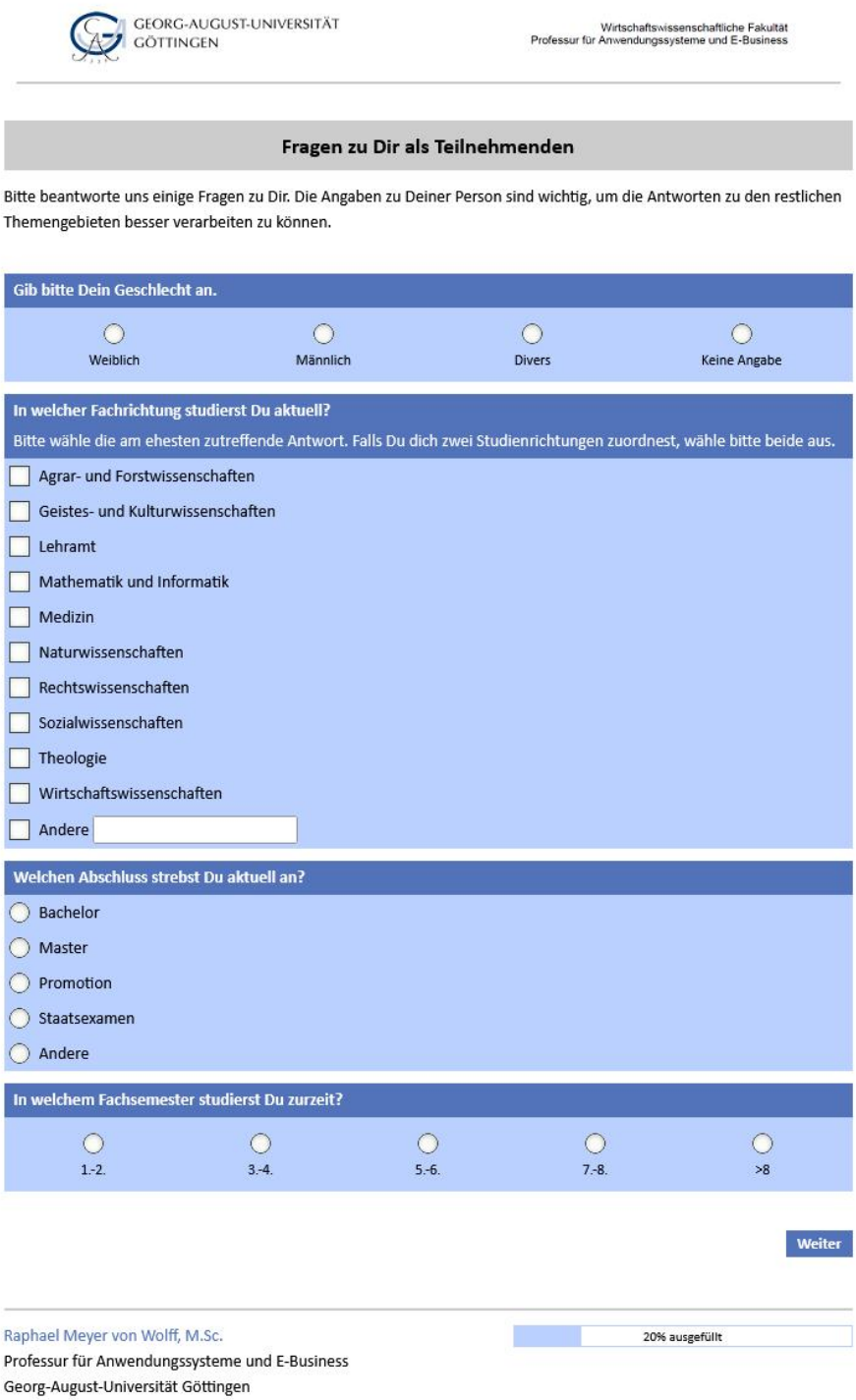
Weiter

Raphael Meyer von Wolff, M.Sc.
Professur für Anwendungssysteme und E-Business
Georg-August-Universität Göttingen

0% ausgefüllt

Figure 69 Appendix 4 – Questionnaire Page 1

[31] As the study was conducted in German, the original questionnaire is shown so as not to distort/change the questions/items through translation.



GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

Wirtschaftswissenschaftliche Fakultät
Professur für Anwendungssysteme und E-Business

Fragen zu Dir als Teilnehmenden

Bitte beantworte uns einige Fragen zu Dir. Die Angaben zu Deiner Person sind wichtig, um die Antworten zu den restlichen Themengebieten besser verarbeiten zu können.

Gib bitte Dein Geschlecht an.

○ Weiblich ○ Männlich ○ Divers ○ Keine Angabe

In welcher Fachrichtung studierst Du aktuell?

Bitte wähle die am ehesten zutreffende Antwort. Falls Du dich zwei Studienrichtungen zuordnest, wähle bitte beide aus.

- ☐ Agrar- und Forstwissenschaften
- ☐ Geistes- und Kulturwissenschaften
- ☐ Lehramt
- ☐ Mathematik und Informatik
- ☐ Medizin
- ☐ Naturwissenschaften
- ☐ Rechtswissenschaften
- ☐ Sozialwissenschaften
- ☐ Theologie
- ☐ Wirtschaftswissenschaften
- ☐ Andere

Welchen Abschluss strebst Du aktuell an?

- ○ Bachelor
- ○ Master
- ○ Promotion
- ○ Staatsexamen
- ○ Andere

In welchem Fachsemester studierst Du zurzeit?

○ 1.-2. ○ 3.-4. ○ 5.-6. ○ 7.-8. ○ >8

Weiter

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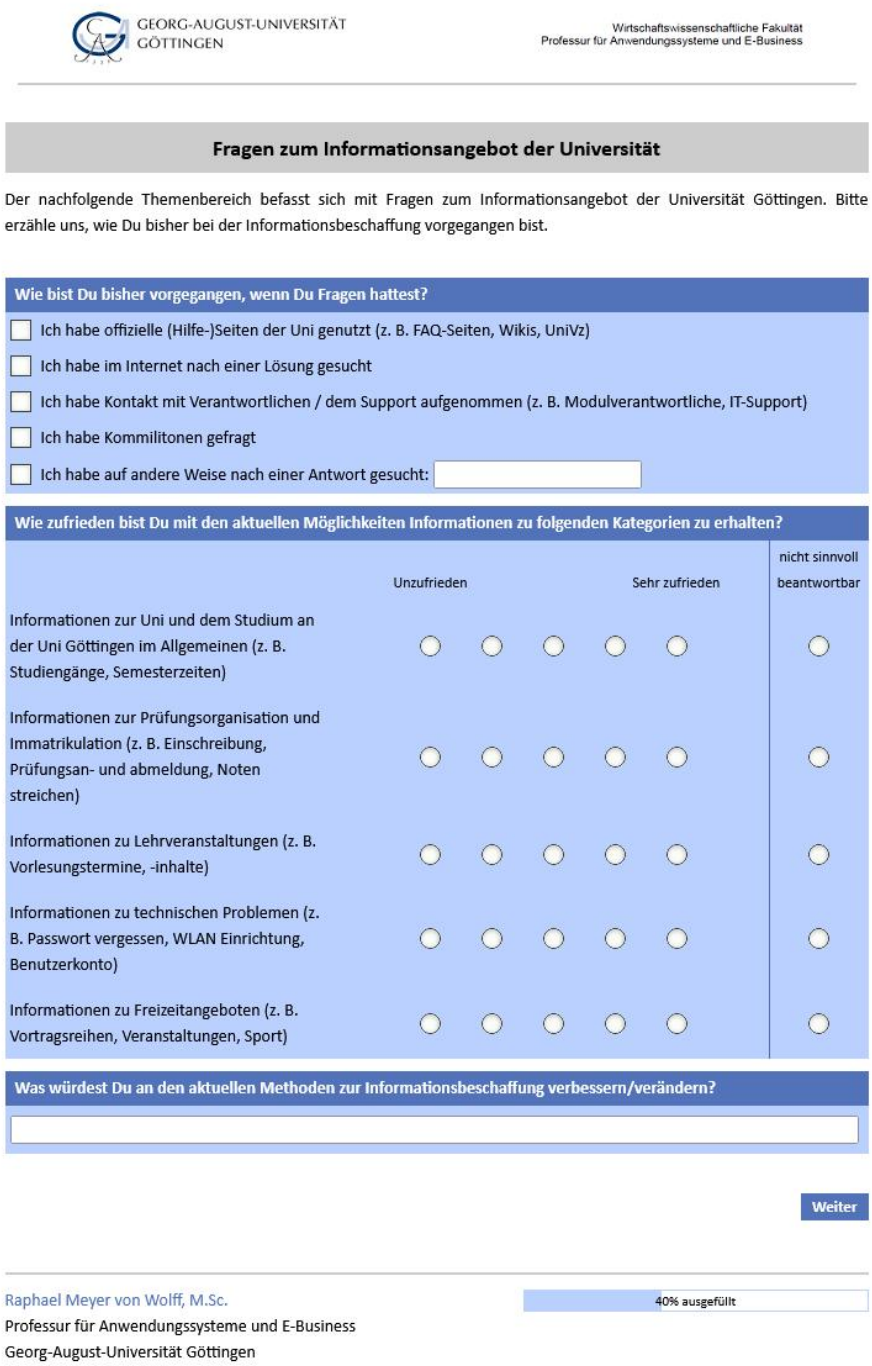
Georg-August-Universität Göttingen

20% ausgefüllt

Figure 70 Appendix 4 – Questionnaire Page 2



GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

Wirtschaftswissenschaftliche Fakultät
Professur für Anwendungssysteme und E-Business

Fragen zum Informationsangebot der Universität

Der nachfolgende Themenbereich befasst sich mit Fragen zum Informationsangebot der Universität Göttingen. Bitte erzähle uns, wie Du bisher bei der Informationsbeschaffung vorgegangen bist.

Wie bist Du bisher vorgegangen, wenn Du Fragen hattest?

- ☐ Ich habe offizielle (Hilfe-)Seiten der Uni genutzt (z. B. FAQ-Seiten, Wikis, UniVz)
- ☐ Ich habe im Internet nach einer Lösung gesucht
- ☐ Ich habe Kontakt mit Verantwortlichen / dem Support aufgenommen (z. B. Modulverantwortliche, IT-Support)
- ☐ Ich habe Kommilitonen gefragt
- ☐ Ich habe auf andere Weise nach einer Antwort gesucht: _____

Wie zufrieden bist Du mit den aktuellen Möglichkeiten Informationen zu folgenden Kategorien zu erhalten?

	Unzufrieden				Sehr zufrieden	nicht sinnvoll beantwortbar
Informationen zur Uni und dem Studium an der Uni Göttingen im Allgemeinen (z. B. Studiengänge, Semesterzeiten)	○	○	○	○	○	○
Informationen zur Prüfungsorganisation und Immatrikulation (z. B. Einschreibung, Prüfungsan- und abmeldung, Noten streichen)	○	○	○	○	○	○
Informationen zu Lehrveranstaltungen (z. B. Vorlesungstermine, -inhalte)	○	○	○	○	○	○
Informationen zu technischen Problemen (z. B. Passwort vergessen, WLAN Einrichtung, Benutzerkonto)	○	○	○	○	○	○
Informationen zu Freizeitangeboten (z. B. Vortragsreihen, Veranstaltungen, Sport)	○	○	○	○	○	○

Was würdest Du an den aktuellen Methoden zur Informationsbeschaffung verbessern/verändern?

Weiter

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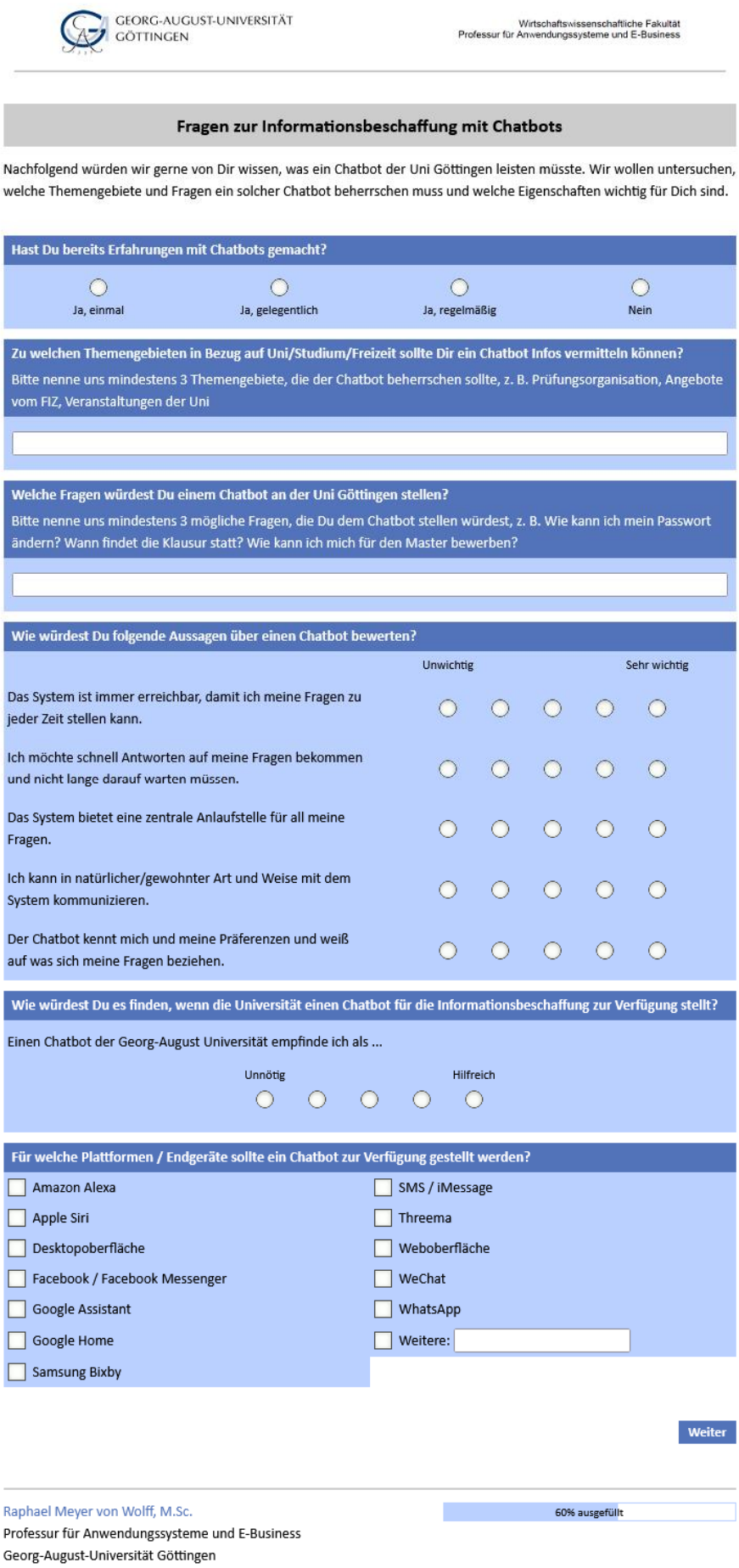
Georg-August-Universität Göttingen

40% ausgefüllt

Figure 71 Appendix 4 – Questionnaire Page 3



GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

Wirtschaftswissenschaftliche Fakultät
Professur für Anwendungssysteme und E-Business

Fragen zur Informationsbeschaffung mit Chatbots

Nachfolgend würden wir gerne von Dir wissen, was ein Chatbot der Uni Göttingen leisten müsste. Wir wollen untersuchen, welche Themengebiete und Fragen ein solcher Chatbot beherrschen muss und welche Eigenschaften wichtig für Dich sind.

Hast Du bereits Erfahrungen mit Chatbots gemacht?

○ Ja, einmal ○ Ja, gelegentlich ○ Ja, regelmäßig ○ Nein

Zu welchen Themengebieten in Bezug auf Uni/Studium/Freizeit sollte Dir ein Chatbot Infos vermitteln können?

Bitte nenne uns mindestens 3 Themengebiete, die der Chatbot beherrschen sollte, z. B. Prüfungsorganisation, Angebote vom FIZ, Veranstaltungen der Uni

Welche Fragen würdest Du einem Chatbot an der Uni Göttingen stellen?

Bitte nenne uns mindestens 3 mögliche Fragen, die Du dem Chatbot stellen würdest, z. B. Wie kann ich mein Passwort ändern? Wann findet die Klausur statt? Wie kann ich mich für den Master bewerben?

Wie würdest Du folgende Aussagen über einen Chatbot bewerten?

	Unwichtig				Sehr wichtig
Das System ist immer erreichbar, damit ich meine Fragen zu jeder Zeit stellen kann.	○	○	○	○	○
Ich möchte schnell Antworten auf meine Fragen bekommen und nicht lange darauf warten müssen.	○	○	○	○	○
Das System bietet eine zentrale Anlaufstelle für all meine Fragen.	○	○	○	○	○
Ich kann in natürlicher/gewohnter Art und Weise mit dem System kommunizieren.	○	○	○	○	○
Der Chatbot kennt mich und meine Präferenzen und weiß auf was sich meine Fragen beziehen.	○	○	○	○	○

Wie würdest Du es finden, wenn die Universität einen Chatbot für die Informationsbeschaffung zur Verfügung stellt?

Einen Chatbot der Georg-August Universität empfinde ich als ...

Unnötig ○ ○ ○ ○ ○ Hilfreich

Für welche Plattformen / Endgeräte sollte ein Chatbot zur Verfügung gestellt werden?

- ☐ Amazon Alexa
- ☐ Apple Siri
- ☐ Desktopoberfläche
- ☐ Facebook / Facebook Messenger
- ☐ Google Assistant
- ☐ Google Home
- ☐ Samsung Bixby
- ☐ SMS / iMessage
- ☐ Threema
- ☐ Weboberfläche
- ☐ WeChat
- ☐ WhatsApp
- ☐ Weitere:

Weiter

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Professur für Anwendungssysteme und E-Business
Georg-August-Universität Göttingen

60% ausgefüllt

Figure 72 Appendix 4 – Questionnaire Page 4

A5 User-Acceptance for IT-Support Chatbots[32]

A5.1 First Task

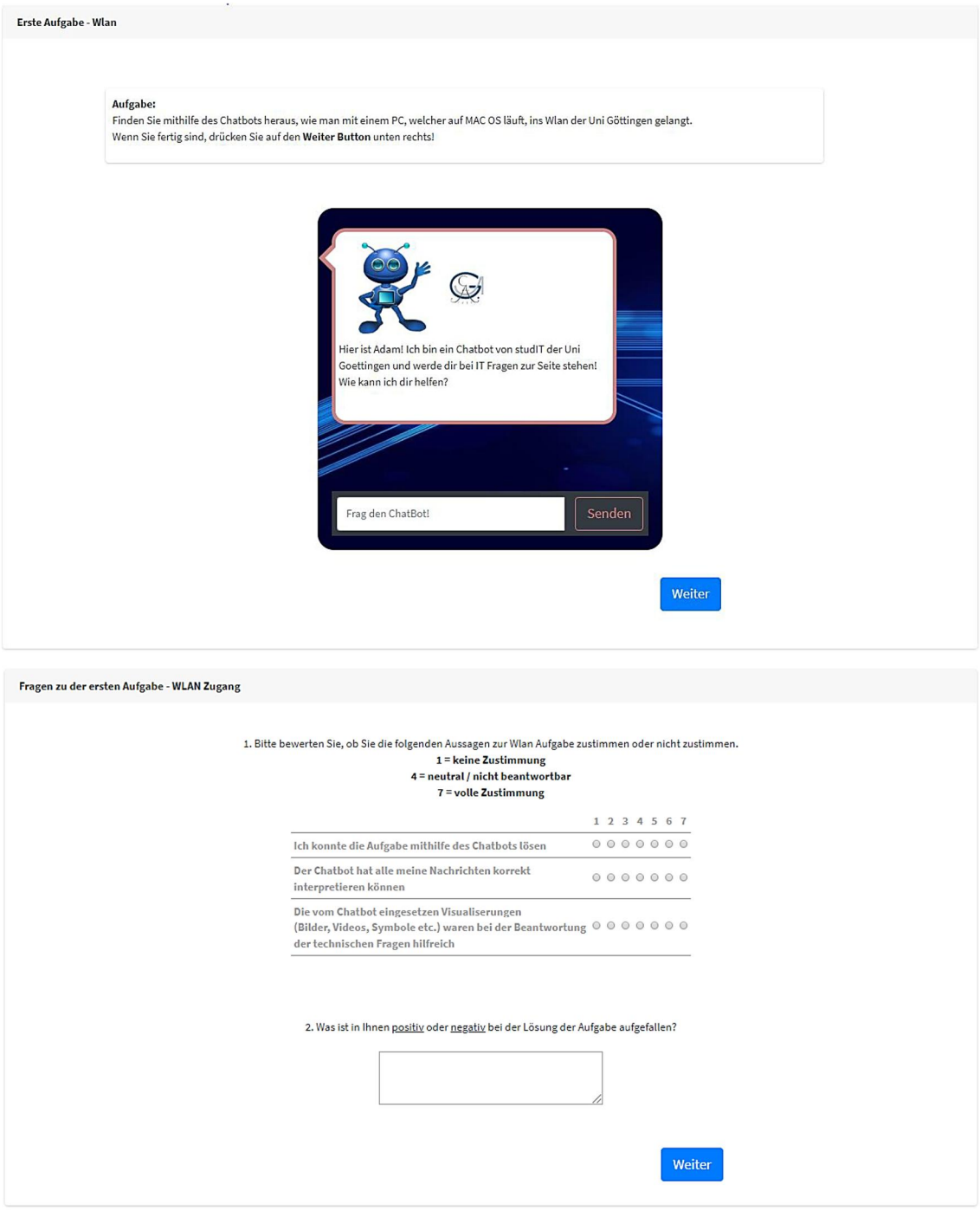


Figure 73 Appendix 5.1 – First Task

[32] As the study was conducted in German, the original scenario and the questionnaire is shown so as not to distort/change the questions/items through translation.

A5.2 Second Task

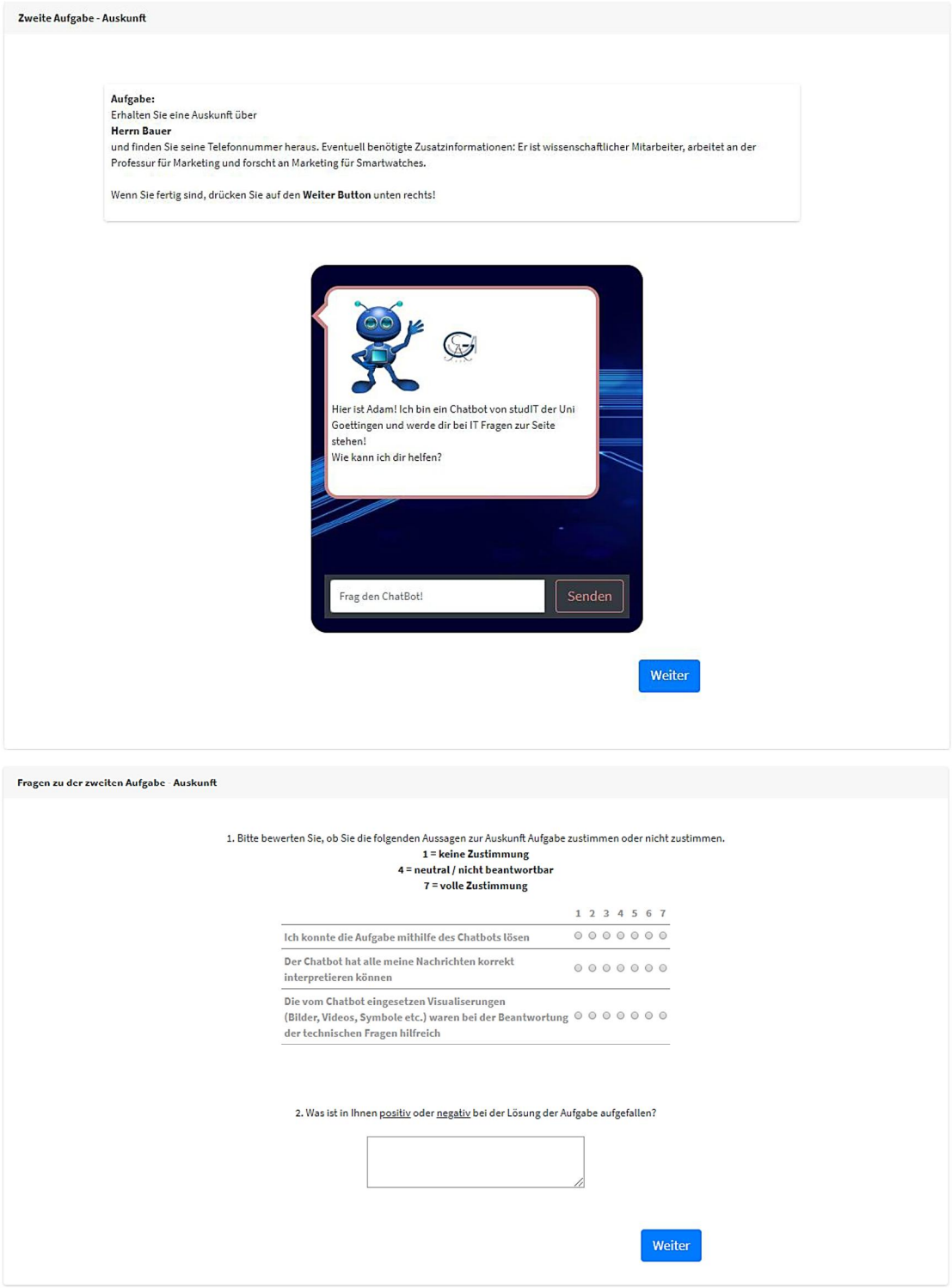


Figure 74 Appendix 5.2 – Second Task

A5.3 Third Task

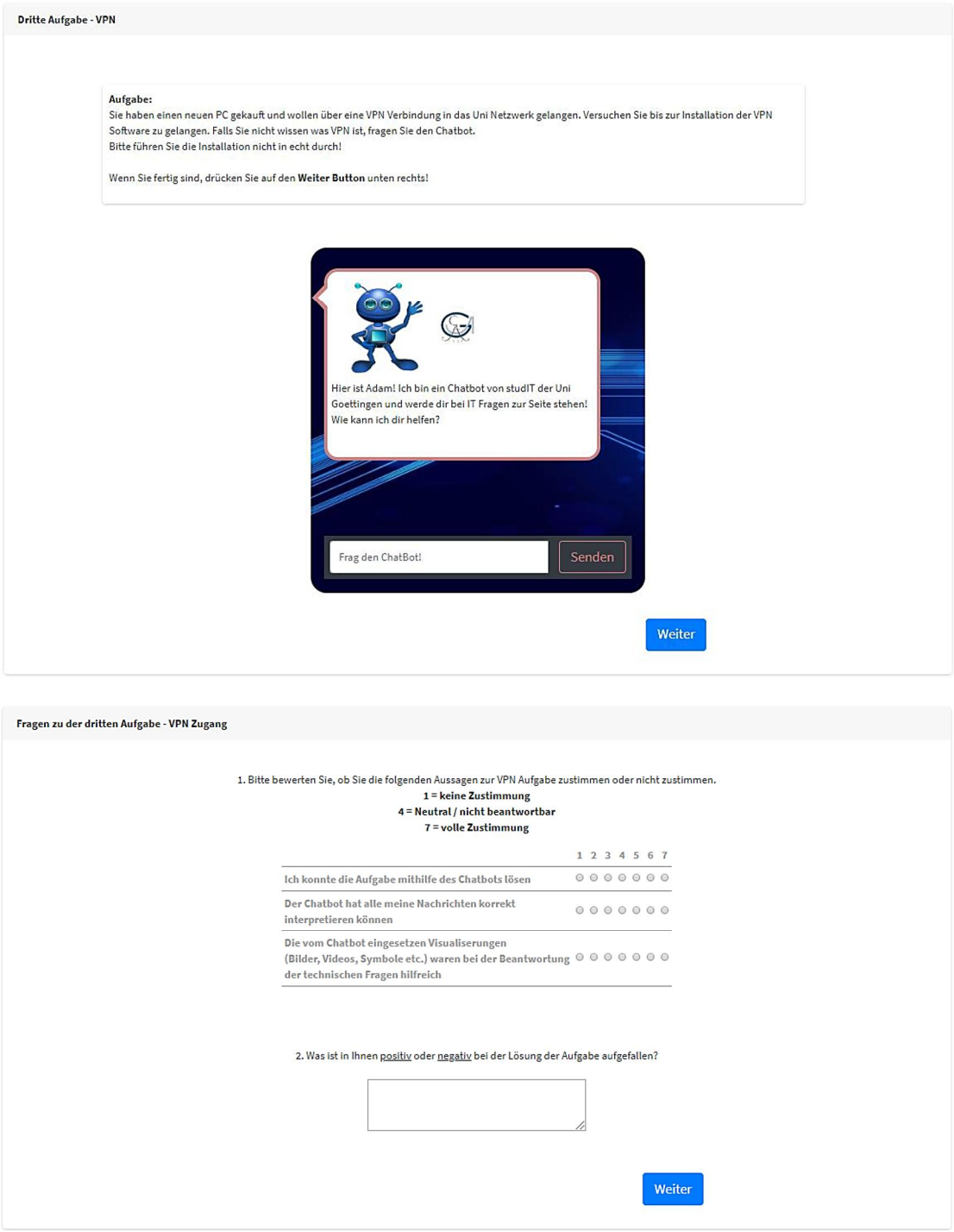
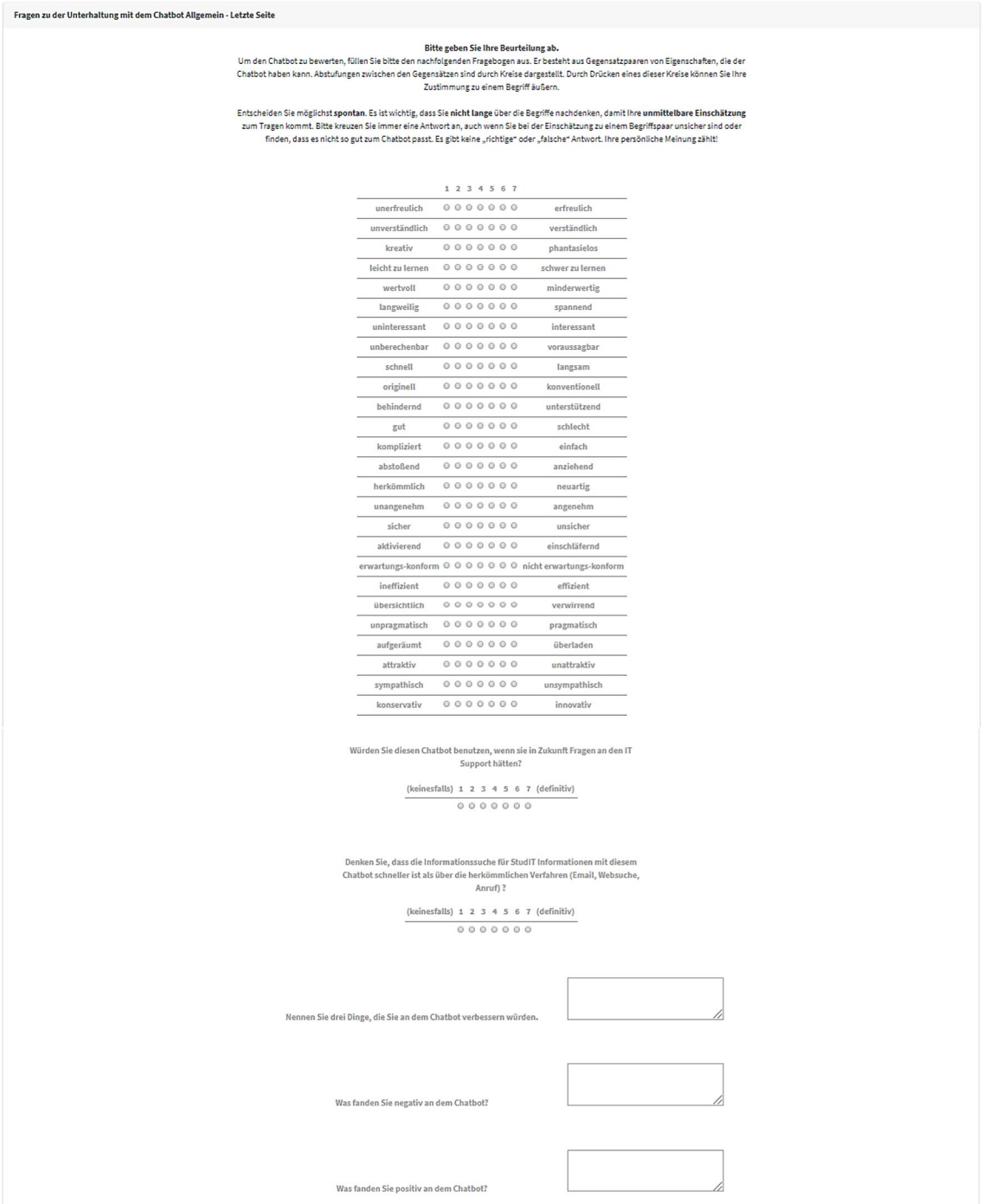


Figure 75 Appendix 5.3 – Third Task

A5.4 General Chatbot Questions



Fragen zu der Unterhaltung mit dem Chatbot Allgemein - Letzte Seite

Bitte geben Sie Ihre Beurteilung ab.

Um den Chatbot zu bewerten, füllen Sie bitte den nachfolgenden Fragebogen aus. Er besteht aus Gegensatzpaaren von Eigenschaften, die der Chatbot haben kann. Abstufungen zwischen den Gegensätzen sind durch Kreise dargestellt. Durch Drücken eines dieser Kreise können Sie Ihre Zustimmung zu einem Begriff äußern.

Entscheiden Sie möglichst **spontan**. Es ist wichtig, dass Sie **nicht lange** über die Begriffe nachdenken, damit Ihre **unmittelbare Einschätzung** zum Tragen kommt. Bitte kreuzen Sie immer eine Antwort an, auch wenn Sie bei der Einschätzung zu einem Begriffspaar unsicher sind oder finden, dass es nicht so gut zum Chatbot passt. Es gibt keine „richtige" oder „falsche" Antwort. Ihre persönliche Meinung zählt!

	1	2	3	4	5	6	7	
unerfreulich	○	○	○	○	○	○	○	erfreulich
unverständlich	○	○	○	○	○	○	○	verständlich
kreativ	○	○	○	○	○	○	○	phantasielos
leicht zu lernen	○	○	○	○	○	○	○	schwer zu lernen
wertvoll	○	○	○	○	○	○	○	minderwertig
langweilig	○	○	○	○	○	○	○	spannend
uninteressant	○	○	○	○	○	○	○	interessant
unberechenbar	○	○	○	○	○	○	○	voraussagbar
schnell	○	○	○	○	○	○	○	langsam
originell	○	○	○	○	○	○	○	konventionell
behindernd	○	○	○	○	○	○	○	unterstützend
gut	○	○	○	○	○	○	○	schlecht
kompliziert	○	○	○	○	○	○	○	einfach
abstoßend	○	○	○	○	○	○	○	anziehend
herkömmlich	○	○	○	○	○	○	○	neuartig
unangenehm	○	○	○	○	○	○	○	angenehm
sicher	○	○	○	○	○	○	○	unsicher
aktivierend	○	○	○	○	○	○	○	einschläfernd
erwartungs-konform	○	○	○	○	○	○	○	nicht erwartungs-konform
ineffizient	○	○	○	○	○	○	○	effizient
übersichtlich	○	○	○	○	○	○	○	verwirrend
unpragmatisch	○	○	○	○	○	○	○	pragmatisch
aufgeräumt	○	○	○	○	○	○	○	überladen
attraktiv	○	○	○	○	○	○	○	unattraktiv
sympathisch	○	○	○	○	○	○	○	unsympathisch
konservativ	○	○	○	○	○	○	○	innovativ

Würden Sie diesen Chatbot benutzen, wenn sie in Zukunft Fragen an den IT Support hätten?

(keinesfalls) 1 2 3 4 5 6 7 (definitiv)

○ ○ ○ ○ ○ ○ ○

Denken Sie, dass die Informationssuche für StudIT Informationen mit diesem Chatbot schneller ist als über die herkömmlichen Verfahren (Email, Websuche, Anruf) ?

(keinesfalls) 1 2 3 4 5 6 7 (definitiv)

○ ○ ○ ○ ○ ○ ○

Nennen Sie drei Dinge, die Sie an dem Chatbot verbessern würden.

Was fanden Sie negativ an dem Chatbot?

Was fanden Sie positiv an dem Chatbot?

Figure 76 Appendix 5.4 – General Chatbot Question

A5.5 Participants Information

Figure 77 Appendix 5.5 – Participant Information

A6 Design of the Process-based Chatbot

A6.1 Requirement Analysis

References	Requirements										
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11
(Bittner/Shoury 2019)	●	●	●		●	●	●				●
(Corea et al. 2020)	●	●		●		●				●	
(Diederich et al. 2020)	●		●	●			●			●	
(Elshan/Ebel 2020)	●	●		●							
(Feine et al. 2020a)	●		●		●	●	●				●
(Gnewuch et al. 2017)	●		●	●							
(Hobert 2019b)	●	●	●					●			
(Johannsen et al. 2018)			●	●						●	
(Lechler et al. 2019)	●	●						●			
(Tavanapour et al. 2019)	●	●	●	●	●						
(Winkler/Roos 2019)	●	●		●		●	●		●		●
(Zierau et al. 2020)	●			●			●			●	

Table 53 Appendix 6.1 – Requirements Analysis for Process-based Chatbots

A6.2 Experts Distribution

Expert	Industry
1	Automotive Engineering
2	Information & Communication Technology
3	Chemicals, Pharmaceuticals & Raw Materials
4	Information & Communication Technology
5	Chemicals, Pharmaceuticals & Raw Materials
6	Information & Communication Technology
7	Information & Communication Technology
8	Finance & Insurance
9	Automotive Engineering
10	Information & Communication Technology
11	Public Sector
12	Finance & Insurance
13	Finance & Insurance

Table 54 Appendix 6.2 – Distribution of the Industries of the Experts

A6.3 Evaluation Scenarios[33]

Scenarios for the Current Form

Evaluation im Rahmen des Dienstreisechatbots: *Spot*

Vielen Dank, dass Sie an der Evaluation des an der Universität Göttingen entwickelten unseres Chatbots teilnehmen. Der Chatbot namens *Spot* unterstützt Sie dabei, Ihre Dienstreisen zu verwalten. Im Folgenden möchten wir zuerst das klassische Vorgehen zur Dienstreiseorganisation evaluieren. Bitte führen Sie das Beispielszenario durch und füllen Sie die entsprechenden Dokumente aus.

In der ersten Evaluation nehmen Sie die Rolle von Martin Müller ein. Der an der Professur für Anwendungssysteme und E-Business arbeitet (Pers.-Nr 15189). E-Mail: m.müller@uni-goettingen.de; Telefon: 0551 39 24479; Wohnhaft: Tulpenweg 10, 37081 Göttingen.

Die Bankdaten sind: Niedersächsische Landesbank, IBAN: DE28 2897 3462 2267 1276 55, BIC: DNR0AGH2DRH

Auf den nächsten Seiten folgen die Beschreibungen der Settings sowie Ihre Aufgaben im Rahmen der Evaluation.

Figure 78 Appendix 6.3 – Evaluation Scenario Current Form Page 1

[33] As the study was conducted in German, the original scenarios are shown in order not to distort them through translation.

Dienstreiseantrag

Szenario:

Die Georg-August-Universität Göttingen arbeitet derzeit zusammen mit der TU München an einem Projekt zur Messung von Kompetenz. Sie und Ihre Kollegin Nicole Schmidt sind in das Projekt involviert und sind zu einem Workshop nach Berlin eingeladen. Das Treffen beginnt am 25.11.2020 um 08:00 Uhr und endet am 27.11.2020 um 15:00 Uhr. Da der Workshop früh morgens beginnt, wollen Sie bereits am Dienstag (24.11.2020) um 16:00 Uhr mit der Bahn anreisen. Da Sie zudem unhandliche Präsentationsunterlagen und -materialien transportieren, wollen Sie zudem vom Bahnhof zur Universität mit dem Taxi fahren. Außerdem möchten Sie sich privat nach dem Workshop noch die Stadt ansehen und erst am 29.11.2020 zurückfahren. Die Ankunft ist für 19:00 Uhr geplant. Für die Unterkunft haben Sie nur noch ein Hotel in der Nähe gefunden. Dies übersteigt die Vorgaben an Übernachtungskosten jedoch um 10 €. Nach erster Schätzung entstehen insgesamt Kosten von ca. 500 €. Die Kosten werden über den Innenauftrag (3388) des Projektes abgerechnet.

Aufgabe:

Füllen Sie den Antrag für Dienstreisen vollständig aus. Leiten Sie das ausgefüllte und gespeicherte Formular im Anschluss an Ihren Vorgesetzten (*Raphael Meyer von Wolff*) per E-Mail zur Genehmigung weiter.

! ! ACHTUNG ! !

Bevor Sie weitermachen, kontaktieren Sie bitte den Verantwortlichen, um den weiteren Verlauf zu besprechen und die notwendigen Unterlagen zu erhalten.

Figure 79 Appendix 6.3 – Evaluation Scenario Current Form Page 2

Dienstreiseabrechnung:

Setting

Im September haben Sie eine Dienstreise nach Den Haag unternommen, um einen wissenschaftlichen Vortrag auf einer Messe zu halten. Nun wollen Sie die Rückerstattung der Dienstreisekosten veranlassen, indem Sie eine Dienstreisekostenabrechnung erstellen und versenden. Ihre Dienstreise haben Sie am 16.09.2020, um 6 Uhr vom Bahnhof in Göttingen gestartet. Von dort aus fuhren Sie mit einem ICE nach Den Haag, welcher dort um 12:00 Uhr ankam. Nach dem kurzen Fußweg zum Hotel erledigten Sie den Check-In und brachten Ihre Reisetasche auf das Zimmer. Anschließend machten Sie sich zu Fuß auf dem Weg zum Messegelände (Ankunft 13:00 Uhr). Am Abend fand ein Social-Event statt, wo auch ein Abendessen bereitgestellt wurde. Am zweiten Tag nahmen Sie ein Taxi zur Messe, um all ihre Unterlagen zu transportieren. Noch am Abend des 17. Septembers fuhren Sie um 18:00 Uhr mit dem ICE zurück nach Göttingen (Ankunft 23:59 Uhr). Insgesamt sind Ihnen auf der Reise die folgenden Kosten für die Bahnfahrten und für die Übernachtung im Hotel entstanden:

Bahn: 62,50 € / Kostenstelle: 8890

Taxi: 12,00 € / Kostenstelle: 8890

Hotel: 80,00 € / Kostenstelle: 8890

***Hinweis I**: Die Belege zu den entstandenen Kosten (DB_Buchung.pdf, Rechnung.pdf) finden Sie im E-Mail-Anhang.*

Aufgabe:

Füllen Sie den Antrag zur Reisekostenabrechnung vollständig aus und versenden Sie diesen an Ihren Vorgesetzten (*Raphael Meyer von Wolff*). Denken Sie auch daran, Belege über entstandene Kosten anzufügen.

Bitte bewerten Sie anschließend den bisherigen Prozess mittels des Fragebogen: https://survey.as.wiwi.uni-goettingen.de/CBEval/?q=UEQ_DR (der Zugangscode wird Ihnen bereitgestellt)

Figure 80 Appendix 6.3 – Evaluation Scenario Current Form Page 3

Scenarios for the Chatbot

Evaluation Dienstreisebot: *Spot*

Vielen Dank, dass Sie an der Evaluierung unseres Chatbots teilnehmen. Der Chatbot namens Spot unterstützt Sie dabei, Ihre Dienstreisen zu verwalten. Im Folgenden stellen wir Ihnen Zugangsdaten für den Chatbot bereit und bitten Sie das Szenario durchzuspielen, welches sowohl das Beantragen als auch das Abrechnen einer Dienstreise umfasst (siehe die nachfolgenden Seiten). Nachdem Sie beide Teilprozesse mit dem Chatbot abgeschlossen haben, werden Sie zudem gebeten, den Chatbot anhand eines Fragebogens zu bewerten.

***Hinweis**: Die personenbezogenen Daten (Vorname, Nachname, Personalnummer, Universitätseinrichtung, Wohnsitz, Kreditinstitut, IBAN, BIC und Telefonnummer) sind für jeden Mitarbeiter in der Datenbank hinterlegt bzw. werden über die Nutzerkennung ermittelt. Die Daten werden vom Chatbot automatisch in den Dienstreise-Antrag bzw. in die Dienstreisekosten-Abrechnung übernommen. So wird der Zeitaufwand für das Eingeben dieser Daten erspart.*

Auf den nächsten Seiten folgen die Beschreibungen der Settings sowie Ihre zwei Aufgaben für die Evaluierung.

Zugang zum System:

Link zum Reisesystem Spot: https://sscb.as.wiwi.uni-goettingen.de/node/

Zugangsdaten siehe E-Mail

Figure 81 Appendix 6.3 – Evaluation Scenario Chatbot Page 1

Dienstreiseantrag

Setting:

Die Georg-August-Universität Göttingen arbeitet derzeit zusammen mit der École Ingénieurs Informatique (EFREI) Paris an einem Chatbot, der Studierenden den Universitätsalltag erleichtern soll. Sie und Ihr Kollege Jens Richter sind in das Projekt involviert und wurden von den Kollegen der EFREI zu einem Workshop nach Paris eingeladen. Der Workshop beginnt am 15.02.2021 um 07:30 Uhr und endet am 17.02.2021 um 20:00 Uhr. Da der Workshop früh morgens beginnt, wollen Sie bereits am Sonntagabend (14.02.2021) um 18:00 Uhr mit der Bahn anreisen. Da Sie zudem unhandliche Präsentationsunterlagen und -materialien transportieren, wollen Sie zudem vom Bahnhof zur Universität mit dem Taxi fahren. Außerdem möchten Sie sich privat nach dem Workshop noch die Stadt ansehen und erst am 21.02.2020 zurückfahren. Die Ankunft ist für 19:00 Uhr geplant. Für die Unterkunft haben Sie noch ein Hotel gefunden, dass den Vorgaben an Übernachtungskosten entspricht. Nach erster Schätzung entstehen insgesamt Kosten von ca. 2000 Euro. Die Kosten werden nach der Dienstreise von der Kostenstelle 3644 gezahlt.

***Hinweis**: Wenn Sie während des Dialogs mit dem Chatbot nach zusätzlichen Angaben gefragt werden (z. B. Zwischenziel), dann können Sie diese verneinen.*

Aufgabe 1:

Nutzen Sie den Chatbot, um Ihre Dienstreise nach Paris zu beantragen.

Figure 82 Appendix 6.3 – Evaluation Scenario Chatbot Page 2

Dienstreiseabrechnung:

Setting

Im April haben Sie eine Dienstreise nach München unternommen, um Ihr Projekt auf einer Messe vorzustellen. Nun wollen Sie die Rückerstattung der Dienstreisekosten veranlassen, indem Sie über den Chatbot eine Dienstreisekosten-Abrechnung erstellen und versenden. Ihre Dienstreise begannen Sie am 01.04.2020 um 6 Uhr vom Bahnhof in Göttingen. Von dort aus fuhren Sie mit einem ICE nach München, welcher um 10:30 Uhr ankam. Nach dem kurzen Fußweg zum Hotel erledigten Sie den Check-In und brachten Ihre Reisetasche auf das Zimmer. Anschließend machten Sie sich zu Fuß auf dem Weg zum Messegelände, wo Sie ein Mittagessen spendiert bekamen. Auch am zweiten Tag der Messe bestritten Sie den kurzen Weg zur Messe zu Fuß und erhielten ein kostenloses Mittagessen. Noch am Abend des 2. April fuhren Sie um 20:00 Uhr mit dem ICE zurück nach Göttingen (Ankunft 23:15 Uhr). Insgesamt sind Ihnen auf der Reise die folgenden Kosten für die Bahnfahrten und für die Übernachtung im Hotel entstanden:

Bahn: 62,50 € nach BahnCard 50 Rabatt / Kostenstelle: 3636

Hotel: 80,00 € / Kostenstelle: 3644

***Hinweis I**: Die Belege (DB_Buchung.pdf, Rechnung.pdf) finden Sie im E-Mail-Anhang. Diese bitte erst auf Ihr Endgerät herunterladen und dann während der Abrechnungserstellung im Chatbot hochladen.*

***Hinweis II**: Wenn Sie während des Dialogs mit dem Chatbot nach zusätzlichen Angaben gefragt werden (z. B. Tagegeld), dann können Sie diese verneinen.*

Aufgabe 2:

Nutzen Sie den Chatbot, um Ihre Dienstreise nach München abzurechnen. Nachdem die Abrechnung versendet wurde, werden Sie automatisch an eine Erhebungssoftware weitergeleitet. Bitte loggen Sie sich mit Ihrem Passwort an und beantworten die gestellten Fragen.

Figure 83 Appendix 6.3 – Evaluation Scenario Chatbot Page 3

A6.4 Questionnaire Table View[34]

	Construct	Theory	Item	Type	Scale	Reference
General	Age		How old are you?	Free Text	-	
	Gender		What is your gender?	Single Choice	Male	
					Female	
					Diverse	
					Not specified	
	Chatbot experience		What is your previous chatbot experience?	5 point-Likert	no use <-> regular use	
	IT-Affinity	Affinity for Technology Interaction Scale	I like to occupy myself in greater detail with technical systems.	6 point-Likert	Do not agree <-> Fully agree	(Franke et al. 2019)
			I like testing the functions of new technical systems.	6 point-Likert	Do not agree <-> Fully agree	
			I predominantly deal with technical systems because I have to.	6 point-Likert	Do not agree <-> Fully agree	
			When I have a new technical system in front of me, I try it out intensively.	6 point-Likert	Do not agree <-> Fully agree	
			I enjoy spending time becoming acquainted with a new technical system.	6 point-Likert	Do not agree <-> Fully agree	
			It is enough for me that a technical system works; I don't care how or why.	6 point-Likert	Do not agree <-> Fully agree	
			I try to understand how a technical system exactly works.	6 point-Likert	Do not agree <-> Fully agree	
			It is enough for me to know the basic functions of a technical system.	6 point-Likert	Do not agree <-> Fully agree	
			I try to make full use of the capabilities of a technical system.	6 point-Likert	Do not agree <-> Fully agree	
	Process Experience		Do you have experience with the university's business travel process?	Single Choice	Yes, I know the business trip organization process of the university	
					No, but I know similar business travel organization processes	
					No, I have no experience with business travel organization processes	
Usability	System Features (DP)		Natural language interaction for process execution	7 point-Likert	Very Negative <-> Very Positive	
			Process guidance including progress overview and forwarding of the process	7 point-Likert	Very Negative <-> Very Positive	
			Adaptation of the process to the user / free choice of procedure	7 point-Likert	Very Negative <-> Very Positive	
			Provided input options (free text, selection errors, buttons, file upload)	7 point-Likert	Very Negative <-> Very Positive	
			Integrated help function for the necessary entries directly in the dialog	7 point-Likert	Very Negative <-> Very Positive	
			Automatic error handling of the entries made	7 point-Likert	Very Negative <-> Very Positive	
	User Experience (UEQ)	User Experience Questionnaire	Please rate the system based on the following items.	7 point-Likert	annoying <-> enjoyable	(Laugwitz et al. 2008; Schrepp et al. 2017)
				7 point-Likert	not understandable <-> understandable	
				7 point-Likert	creative <-> dull	
				7 point-Likert	easy to learn <-> difficult to learn	
				7 point-Likert	valuable <-> inferior	
				7 point-Likert	boring <-> exciting	
				7 point-Likert	not interesting <-> interesting	
				7 point-Likert	unpredictable <-> predictable	
				7 point-Likert	fast <-> slow	
				7 point-Likert	inventive <-> conventional	
				7 point-Likert	obstructive <-> supportive	
				7 point-Likert	good <-> bad	
				7 point-Likert	complicated <-> easy	
				7 point-Likert	unlikable <-> pleasing	
				7 point-Likert	usual <-> leading edge	
				7 point-Likert	unpleasant <-> pleasant	
				7 point-Likert	secure <-> not secure	
				7 point-Likert	motivating <-> demotivating	
				7 point-Likert	meets expectations <-> does not meet expectations	
				7 point-Likert	inefficient <-> efficient	
				7 point-Likert	clear <-> confusing	
				7 point-Likert	impractical <-> practical	
				7 point-Likert	organized <-> cluttered	
				7 point-Likert	attractive <-> unattractive	
				7 point-Likert	friendly <-> unfriendly	
				7 point-Likert	conservative <-> innovative	

Table 55 Appendix 6.4 – Evaluation Questionnaire Table View I

[34] Items translated from German.

	Construct	Theory	Item	Type	Scale	Reference
Acceptance	Information Quality (IQ)	Information Systems Success Model	The chatbot presents the information/answers in a useful format.	7 point-Likert	Do not agree <-> Fully agree	(Yu/Qian 2018)
			The outputs of the chatbot are easy to understand.	7 point-Likert	Do not agree <-> Fully agree	(Freeze et al. 2010)
			The chatbot provides the information I need to organize business trips.	7 point-Likert	Do not agree <-> Fully agree	(Freeze et al. 2010)
			The chatbot provides relevant information for the business trip organization/substeps.	7 point-Likert	Do not agree <-> Fully agree	(Freeze et al. 2010)
	Service Quality (SQ)	Information Systems Success Model	When using the chatbot, I feel safe in terms of data protection and data security.	7 point-Likert	Do not agree <-> Fully agree	(Alshibly 2014)
			The messages and results of the chatbot are complete for the business trip organization.	7 point-Likert	Do not agree <-> Fully agree	(Ojo 2017)
			The chatbot supports me individually in organizing business trips.	7 point-Likert	Do not agree <-> Fully agree	(Alshibly 2014)
			If I have a problem using it, the chatbot helps me find a solution.	7 point-Likert	Do not agree <-> Fully agree	(Alshibly 2014)
	Perceived usefulness (PU)	Technology Acceptance Model	Using the chatbot allows me to do the business trip organization quickly.	7 point-Likert	Do not agree <-> Fully agree	(Davis 1989)
			Using the Chabot makes it easier for me to organize business trips.	7 point-Likert	Do not agree <-> Fully agree	(Davis 1989)
			Using the chatbot for business travel organization increases my productivity.	7 point-Likert	Do not agree <-> Fully agree	(Davis 1989)
			I find the chatbot useful for business travel organization.	7 point-Likert	Do not agree <-> Fully agree	(Venkatesh/Bala 2008)
			Using the chatbot for business travel organization increases my effectiveness.	7 point-Likert	Do not agree <-> Fully agree	(Davis 1989)
	Perceived ease of use (PEoU)	Technology Acceptance Model	My interaction with the system is clear and understandable.	7 point-Likert	Do not agree <-> Fully agree	(Venkatesh/Davis 2000)
			I find it easy to get the system to do what I want.	7 point-Likert	Do not agree <-> Fully agree	(Venkatesh/Bala 2008)
			Using the chatbot is easy for me to learn.	7 point-Likert	Do not agree <-> Fully agree	(Davis 1989)
			I find the chatbot easy to use.	7 point-Likert	Do not agree <-> Fully agree	(Venkatesh/Davis 2000)
			Using the chatbot for business travel organization requires little mental effort.	7 point-Likert	Do not agree <-> Fully agree	(Venkatesh/Davis 2000)
	Behavioral intention to use (BI)	Technology Acceptance Model	If I have access to the chatbot, I would probably use it for business travel organization.	7 point-Likert	Do not agree <-> Fully agree	(Venkatesh/Davis 2000)
			I would recommend the chatbot for organizing the business trip.	7 point-Likert	Do not agree <-> Fully agree	(Constantinides et al. 2013)
			Provided I have access to the chatbot, I will use it for business travel organization in the future.	7 point-Likert	Do not agree <-> Fully agree	(Venkatesh/Davis 2000)
	User Satisfaction (US)	Information Systems Success Model	The chatbot for business travel organization has met my expectations.	7 point-Likert	Do not agree <-> Fully agree	(Alshibly 2014)
			Overall, I am satisfied with the chatbot for business trip organization.	7 point-Likert	Do not agree <-> Fully agree	(Yu/Qian 2018)
			I find the chatbot very helpful for business travel organization.	7 point-Likert	Do not agree <-> Fully agree	(Freeze et al. 2010)

Table 56 Appendix 6.4 – Evaluation Questionnaire Table View II

A6.5 Questionnaire Instantiation[35]

GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

Professur für Anwendungssysteme und E-Business

Einsatz von Chatbots am digitalen Büroarbeitsplatz

Evaluation eines Prozess-basierten Chatbots am Beispiel des Dienstreiseorganisationsprozesses

Sehr geehrte Teilnehmerin, sehr geehrter Teilnehmer,

Sie haben sich bereit erklärt, im Rahmen des oben genannten Forschungsprojektes an einer Evaluation teilzunehmen. Aus diesem Grund möchten wir Sie bitten, die folgenden Fragen zu beantworten **(Dauer ca. 10 Minuten)**. Ihre Angaben werden selbstverständlich vertraulich behandelt und unterliegen dem Datenschutz.

Für die Zeit und Unterstützung möchte ich mich bereits vorab bedanken.

Grundlegende Begriffe

Chatbots sind dialogbasierte Anwendungssysteme, welche die Ausführung von Aufgaben und Prozessen in intuitiver, natürlichsprachlicher – textueller oder audiobasierter – Art und Weise aus einem Chat heraus ermöglichen sollen. Aktuell bekannte Umsetzungen sind z. B. IKEA Anna, Apple Siri oder Amazon Alexa.

Digitale Büroarbeitsplätze stellen die Koordination zwischen (IT-)Technologien, Prozessen und Personen zur informationsbasierten Aufgabenerfüllung im Unternehmen dar. Der Fokus liegt auf der Arbeit mit Informationen und einer hohen Relevanz von Kommunikation unter den beteiligten Akteuren und Systemen.

Weiter

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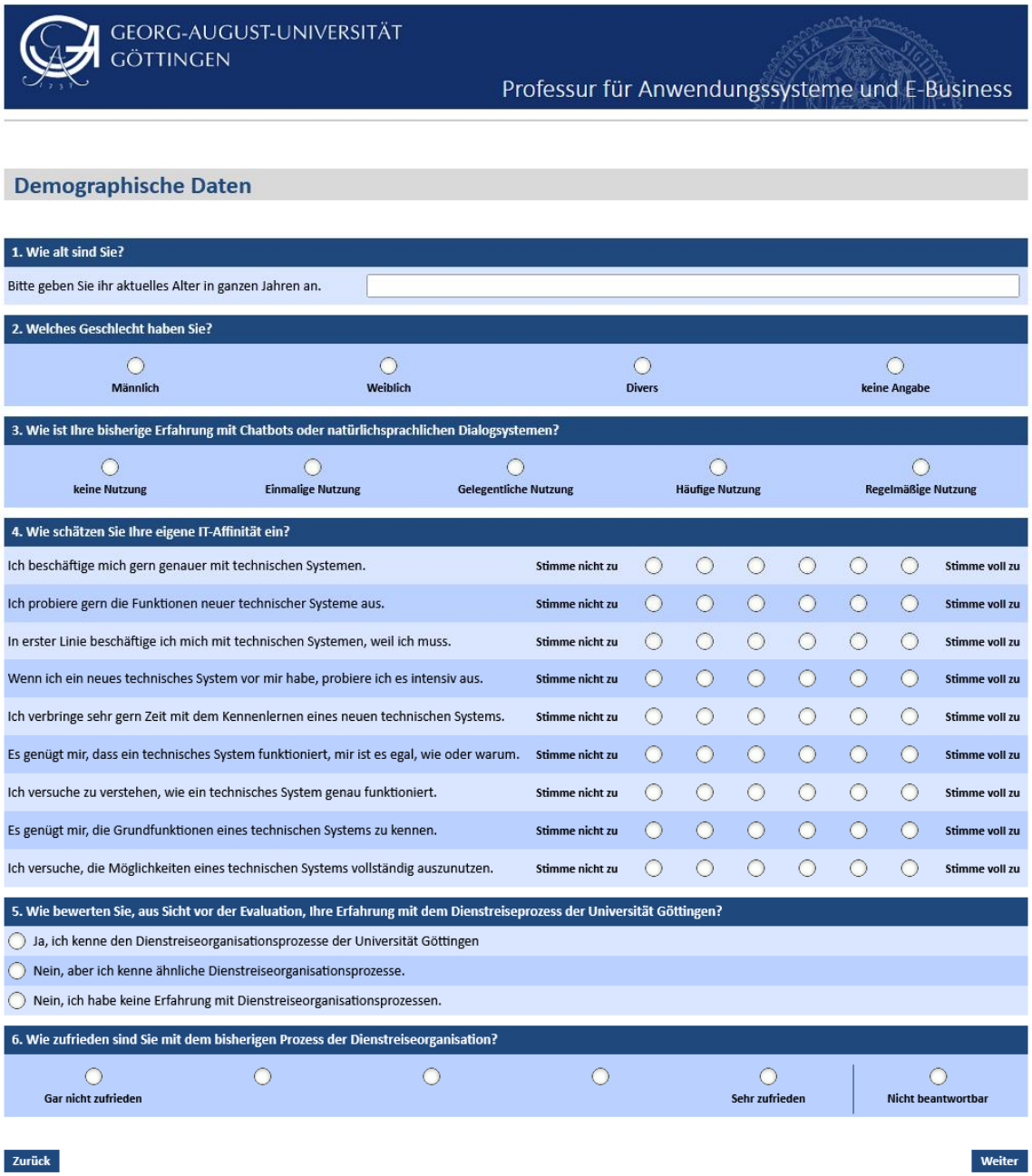
Georg-August-Universität Göttingen – 2020

0% ausgefüllt

Figure 84 Appendix 6.5 – Evaluation Questionnaire Page 1

[35] As the study was conducted in German, the original questionnaire is shown in order not to falsify/change the questions/items through translation.


GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

Professur für Anwendungssysteme und E-Business

Demographische Daten

1. Wie alt sind Sie?

Bitte geben Sie ihr aktuelles Alter in ganzen Jahren an.

2. Welches Geschlecht haben Sie?

Männlich | Weiblich | Divers | keine Angabe

3. Wie ist Ihre bisherige Erfahrung mit Chatbots oder natürlichsprachlichen Dialogsystemen?

keine Nutzung | Einmalige Nutzung | Gelegentliche Nutzung | Häufige Nutzung | Regelmäßige Nutzung

4. Wie schätzen Sie Ihre eigene IT-Affinität ein?

Ich beschäftige mich gern genauer mit technischen Systemen.	Stimme nicht zu	○	○	○	○	○	○	Stimme voll zu
Ich probiere gern die Funktionen neuer technischer Systeme aus.	Stimme nicht zu	○	○	○	○	○	○	Stimme voll zu
In erster Linie beschäftige ich mich mit technischen Systemen, weil ich muss.	Stimme nicht zu	○	○	○	○	○	○	Stimme voll zu
Wenn ich ein neues technisches System vor mir habe, probiere ich es intensiv aus.	Stimme nicht zu	○	○	○	○	○	○	Stimme voll zu
Ich verbringe sehr gern Zeit mit dem Kennenlernen eines neuen technischen Systems.	Stimme nicht zu	○	○	○	○	○	○	Stimme voll zu
Es genügt mir, dass ein technisches System funktioniert, mir ist es egal, wie oder warum.	Stimme nicht zu	○	○	○	○	○	○	Stimme voll zu
Ich versuche zu verstehen, wie ein technisches System genau funktioniert.	Stimme nicht zu	○	○	○	○	○	○	Stimme voll zu
Es genügt mir, die Grundfunktionen eines technischen Systems zu kennen.	Stimme nicht zu	○	○	○	○	○	○	Stimme voll zu
Ich versuche, die Möglichkeiten eines technischen Systems vollständig auszunutzen.	Stimme nicht zu	○	○	○	○	○	○	Stimme voll zu

5. Wie bewerten Sie, aus Sicht vor der Evaluation, Ihre Erfahrung mit dem Dienstreiseprozess der Universität Göttingen?

- ○ Ja, ich kenne den Dienstreiseorganisationsprozesse der Universität Göttingen
- ○ Nein, aber ich kenne ähnliche Dienstreiseorganisationsprozesse.
- ○ Nein, ich habe keine Erfahrung mit Dienstreiseorganisationsprozessen.

6. Wie zufrieden sind Sie mit dem bisherigen Prozess der Dienstreiseorganisation?

Gar nicht zufrieden | ○ | ○ | ○ | Sehr zufrieden | Nicht beantwortbar

Zurück | Weiter

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20% ausgefüllt

Figure 85 Appendix 6.5 – Evaluation Questionnaire Page 2

GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

Professur für Anwendungssysteme und E-Business

Akzeptanz des Chatbots

7. Bitte bewerten Sie die folgenden Aussagen zur Informationsqualität									
Der Chatbot stellt die Informationen/Antworten in einem nützlichen Format dar.	Stimme nicht zu	○	○	○	○	○	○	○	Stimme voll zu
Die Ausgaben des Chatbots sind leicht zu verstehen.	Stimme nicht zu	○	○	○	○	○	○	○	Stimme voll zu
Der Chatbot stellt die Informationen zur Verfügung, die ich für die Dienstreiseorganisation benötige.	Stimme nicht zu	○	○	○	○	○	○	○	Stimme voll zu
Der Chatbot liefert relevante Informationen für die Dienstreiseorganisation/die Teilschritte.	Stimme nicht zu	○	○	○	○	○	○	○	Stimme voll zu
8. Bitte bewerten Sie die folgenden Aussagen zur Servicequalität.									
Bei der Nutzung des Chatbots fühle ich mich hinsichtlich Datenschutz und Datensicherheit sicher.	Stimme nicht zu	○	○	○	○	○	○	○	Stimme voll zu
Die Nachrichten und Ergebnisse des Chatbots sind für die Dienstreiseorganisation vollständig.	Stimme nicht zu	○	○	○	○	○	○	○	Stimme voll zu
Der Chatbot unterstützt mich individuell bei der Dienstreiseorganisation.	Stimme nicht zu	○	○	○	○	○	○	○	Stimme voll zu
Wenn ich ein Problem bei der Nutzung habe, unterstützt mich der Chatbot bei der Lösungsfindung.	Stimme nicht zu	○	○	○	○	○	○	○	Stimme voll zu
9. Bitte bewerten Sie die folgenden Aussagen zur Nützlichkeit.									
Das Verwenden des Chatbots ermöglicht es mir die Dienstreiseorganisation schnell zu erledigen.	Stimme nicht zu	○	○	○	○	○	○	○	Stimme voll zu
Das Verwenden des Chabots erleichtert mir die Dienstreiseorganisation.	Stimme nicht zu	○	○	○	○	○	○	○	Stimme voll zu
Das Verwenden des Chatbots für die Dienstreiseorganisation steigert meine Produktivität.	Stimme nicht zu	○	○	○	○	○	○	○	Stimme voll zu
Ich finde den Chatbot für die Dienstreiseorganisation nützlich.	Stimme nicht zu	○	○	○	○	○	○	○	Stimme voll zu
Das Verwenden des Chatbots für die Dienstreiseorganisation steigert meine Effektivität.	Stimme nicht zu	○	○	○	○	○	○	○	Stimme voll zu
10. Bitte bewerten Sie die folgenden Aussagen zur Benutzungsfreundlichkeit.									
Meine Interaktion mit dem System ist klar und nachvollziehbar.	Stimme nicht zu	○	○	○	○	○	○	○	Stimme voll zu
Ich finde es einfach, das System dazu zu bringen, das zu tun, was ich will.	Stimme nicht zu	○	○	○	○	○	○	○	Stimme voll zu
Der Umgang mit dem Chatbot ist für mich einfach zu erlernen.	Stimme nicht zu	○	○	○	○	○	○	○	Stimme voll zu
Ich finde den Chatbot einfach zu bedienen.	Stimme nicht zu	○	○	○	○	○	○	○	Stimme voll zu
Das Verwenden des Chatbots für die Dienstreiseorganisation erfordert wenig mentale Anstrengung.	Stimme nicht zu	○	○	○	○	○	○	○	Stimme voll zu
11. Bitte bewerten Sie die folgenden Aussagen zur Nutzungsintention.									
Wenn ich Zugang zum Chatbot habe, würde ich ihn wahrscheinlich für die Dienstreiseorganisation nutzen.	Stimme nicht zu	○	○	○	○	○	○	○	Stimme voll zu
Ich würde den Chatbot für die Organisation der Dienstreise weiterempfehlen.	Stimme nicht zu	○	○	○	○	○	○	○	Stimme voll zu
Sofern ich Zugang zum Chatbot habe, werde ich ihn in Zukunft für die Dienstreiseorganisation nutzen.	Stimme nicht zu	○	○	○	○	○	○	○	Stimme voll zu
12. Bitte bewerten Sie die folgenden Aussagen zur Benutzungszufriedenheit.									
Der Chatbot zur Dienstreiseorganisation hat meine Erwartungen erfüllt.	Stimme nicht zu	○	○	○	○	○	○	○	Stimme voll zu
Insgesamt bin ich mit dem Chatbot zur Dienstreiseorganisation zufrieden.	Stimme nicht zu	○	○	○	○	○	○	○	Stimme voll zu
Ich finde den Chatbot für die Dienstreiseorganisation sehr hilfreich.	Stimme nicht zu	○	○	○	○	○	○	○	Stimme voll zu

Zurück Weiter

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40% ausgefüllt

Figure 86 Appendix 6.5 – Evaluation Questionnaire Page 3

GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

Professur für Anwendungssysteme und E-Business

Usability des Chatbots

13. Wie bewerten Sie die Umsetzung der folgenden Systemfunktionalitäten.									
Natürlichsprachliche Benutzungsoberfläche	Sehr negativ	○	○	○	○	○	○	○	Sehr positiv
Prozessführung inklusive Fortschrittsübersicht	Sehr negativ	○	○	○	○	○	○	○	Sehr positiv
Individualisierte Adaption des Prozesses auf den Nutzer und freie Wahl des Vorgehens	Sehr negativ	○	○	○	○	○	○	○	Sehr positiv
Verschiedene Eingabemöglichkeiten (Freitext, Auswahlfehlder, Buttons, Dateiupload)	Sehr negativ	○	○	○	○	○	○	○	Sehr positiv
Integrierte Hilfefunktion direkt im Dialog	Sehr negativ	○	○	○	○	○	○	○	Sehr positiv
Automatische Fehlerüberprüfung	Sehr negativ	○	○	○	○	○	○	○	Sehr positiv

14. Bitte bewerten Sie das System anhand der folgenden Auswahlpaare.								
unerfreulich	○	○	○	○	○	○	○	erfreulich
unverständlich	○	○	○	○	○	○	○	verständlich
kreativ	○	○	○	○	○	○	○	phantasielos
leicht zu lernen	○	○	○	○	○	○	○	schwer zu lernen
wertvoll	○	○	○	○	○	○	○	minderwertig
langweilig	○	○	○	○	○	○	○	spannend
uninteressant	○	○	○	○	○	○	○	interessant
unberechenbar	○	○	○	○	○	○	○	voraussagbar
schnell	○	○	○	○	○	○	○	langsam
originell	○	○	○	○	○	○	○	konventionell
behindernd	○	○	○	○	○	○	○	unterstützend
gut	○	○	○	○	○	○	○	schlecht
kompliziert	○	○	○	○	○	○	○	einfach
abstoßend	○	○	○	○	○	○	○	anziehend
herkömmlich	○	○	○	○	○	○	○	neuartig
unangenehm	○	○	○	○	○	○	○	angenehm
sicher	○	○	○	○	○	○	○	unsicher
aktivierend	○	○	○	○	○	○	○	einschläfernd
erwartungskonform	○	○	○	○	○	○	○	nicht erwartungskonform
ineffizient	○	○	○	○	○	○	○	effizient
übersichtlich	○	○	○	○	○	○	○	verwirrend
unpragmatisch	○	○	○	○	○	○	○	pragmatisch
aufgeräumt	○	○	○	○	○	○	○	überladen
attraktiv	○	○	○	○	○	○	○	unattraktiv
sympathisch	○	○	○	○	○	○	○	unsympathisch
konservativ	○	○	○	○	○	○	○	innovativ

Zurück Weiter

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60% ausgefüllt

Figure 87 Appendix 6.5 – Evaluation Questionnaire Page 4

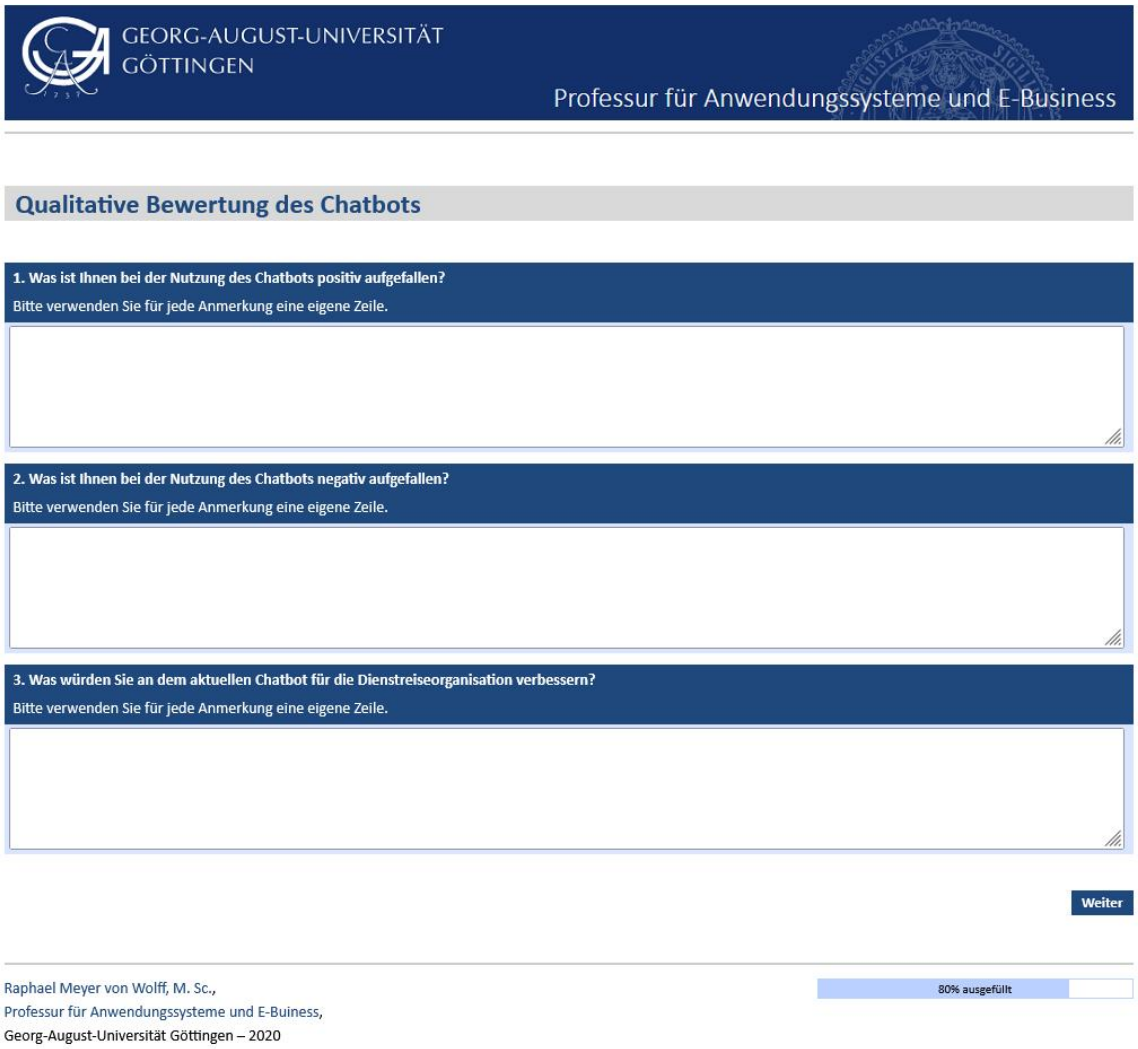
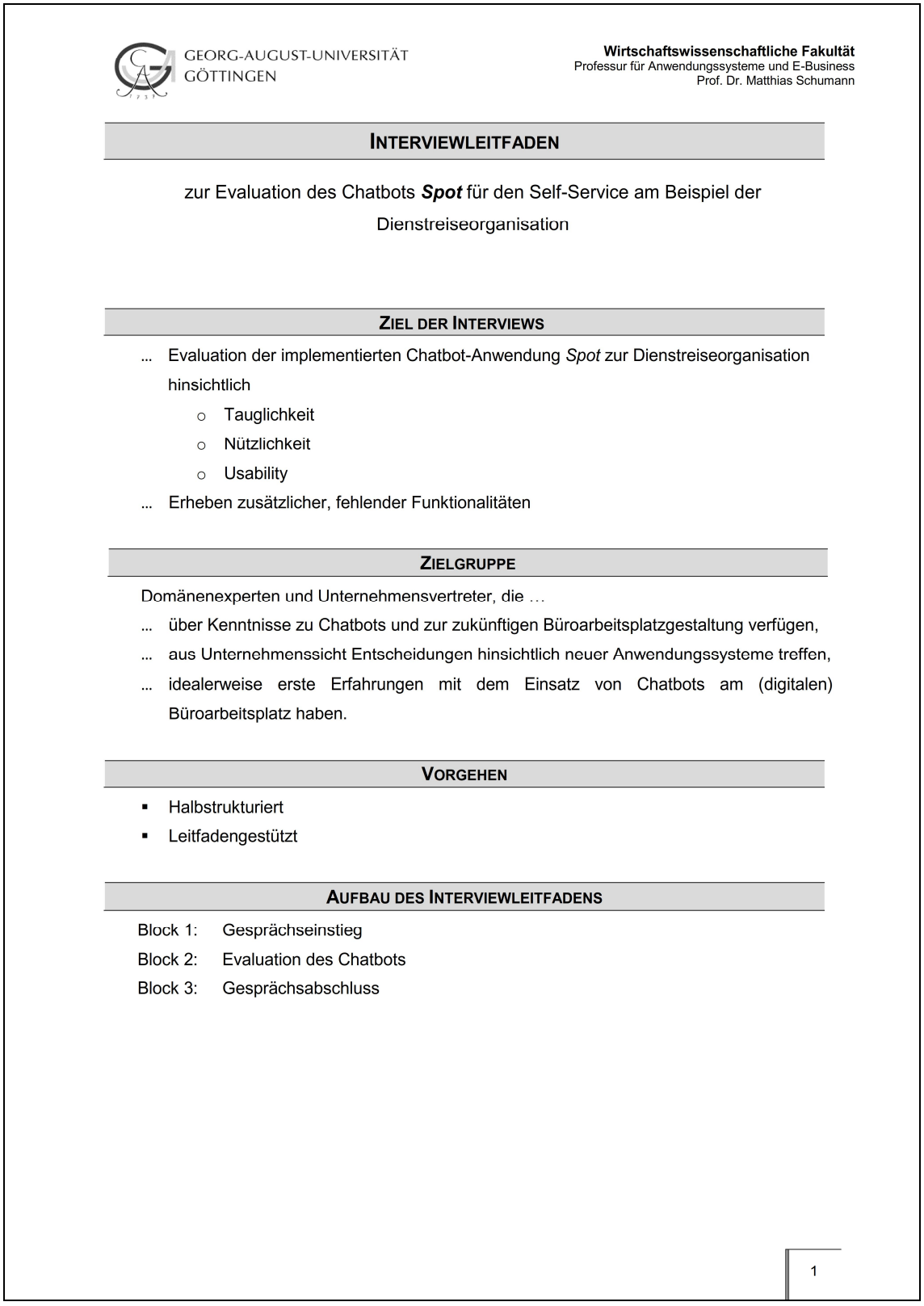


Figure 88 Appendix 6.5 – Evaluation Questionnaire Page 5

A6.6 Structured Interview Guideline[36]



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Professur für Anwendungssysteme und E-Business
Prof. Dr. Matthias Schumann

INTERVIEWLEITFADEN

zur Evaluation des Chatbots ***Spot*** für den Self-Service am Beispiel der Dienstreiseorganisation

ZIEL DER INTERVIEWS

... Evaluation der implementierten Chatbot-Anwendung *Spot* zur Dienstreiseorganisation hinsichtlich
  - Tauglichkeit
  - Nützlichkeit
  - Usability

... Erheben zusätzlicher, fehlender Funktionalitäten

ZIELGRUPPE

Domänenexperten und Unternehmensvertreter, die …

... über Kenntnisse zu Chatbots und zur zukünftigen Büroarbeitsplatzgestaltung verfügen,

... aus Unternehmenssicht Entscheidungen hinsichtlich neuer Anwendungssysteme treffen,

... idealerweise erste Erfahrungen mit dem Einsatz von Chatbots am (digitalen) Büroarbeitsplatz haben.

VORGEHEN

- Halbstrukturiert
- Leitfadengestützt

AUFBAU DES INTERVIEWLEITFADENS

Block 1: Gesprächseinstieg
Block 2: Evaluation des Chatbots
Block 3: Gesprächsabschluss

1

Figure 89 Appendix 6.6 – Structured Interview Guideline - Page 1

[36] As the study was conducted in German, the original guideline is shown in order not to distort/change the statements/questions through translation.

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BLOCK 1: GESPRÄCHSEINSTIEG

Begrüßung und Vorstellung

- Begrüßung der Interviewteilnehmer und Danksagung für die Bereitschaft zur Teilnahme
  [Einleitung:] *Sehr geehrter Herr / Frau [TeilnehmerIn]. Danke, dass wir die Möglichkeit haben unseren Prototypen vorzustellen und die Evaluation mit Ihnen durchzuführen.*
- Kurzvorstellung der Interviewer
- Bitte um kurze Vorstellung der/des Interviewpartner(s)

Einführung in das Forschungsvorhaben

- Vorstellung der Inhalte und Zielsetzungen des Forschungsvorhabens
- Kurze Erklärung zu den Begriffen Chatbots sowie digitaler Büroarbeitsplatz
  - Gibt es Ihrerseits noch offene Fragen / Unklarheiten zu den Forschungsdomänen?

Klärung formaler Rahmenbedingungen

- Datenschutz und Einverständnis zur Aufzeichnung
  - Selbstverständlich werden die in diesem Interview gemachten Angaben von uns vertraulich behandelt und unterliegen der vorliegenden Datenschutzerklärung
  - Zu Auswertungszwecken würden wir das Interview gerne aufzeichnen. Die Audioaufnahme wird im Anschluss transkribiert und anonymisiert, sodass keinerlei Rückschlüsse auf Sie oder Ihr Unternehmen möglich sind. Die Auswertung der Interviews erfolgt auf Grundlage dieser anonymisierten Abschriften für wissenschaftliche Zwecke.
    [Falls noch nicht vorliegend, Datenschutz- und Einwilligungserklärung einholen]

- Interview/Evaluationsablauf
  - Das Interview/die Evaluation wird etwa 45 Minuten in Anspruch nehmen. Es basiert auf einzelnen Aufgaben, einem Fragebogen sowie einem halbstrukturierten Interview. Sie können gerne jederzeit eigene Fragen oder Anmerkungen einfließen lassen.
  - Haben Sie bis hierhin Fragen zum Inhalt oder Ablauf des Interviews/der Evaluation?

[Falls Einverständnis zur Aufzeichnung; Tonaufnahme starten!]

Figure 90 Appendix 6.6 – Structured Interview Guideline - Page 2

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BLOCK 2: EVALUATION DES CHATBOTS *SPOT*

[Vorstellung des Prototypen]: *Der Proband führt eine Teilaufgabe mit dem Chatbot durch und beantwortet im Anschluss einen standardisierten Fragebogen.*

Wie ist Ihr erster Eindruck in Bezug auf die Dienstreiseorganisation mit dem Chatbot?

Was fanden Sie am Chatbot positiv? Welche Funktionen fanden Sie am hilfreichsten?

Was fanden Sie am Chatbot negativ? Welche Funktionen fanden Sie am hinderlichsten?

Wie finden Sie die folgenden Funktionen:

Natürlichsprachliche Interaktion zur Prozessausführung

Prozessführung inklusive Fortschrittsübersicht und Weiterleitung des Prozesses

Adaption des Prozesses auf den Nutzer / Freie Wahl des Vorgehens

Bereitgestellte Eingabemöglichkeiten (Freitext, Auswahlfelder, Buttons, Dateiupload)

Integrierte Hilfefunktion zu den notwendigen Eingaben direkt im Dialog

Automatische Fehlerüberprüfung der gemachten Eingaben

Was würden Sie am Chatbot verbessern? Fehlen Ihnen Funktionen, die für einen Praxiseinsatz in Ihrem Unternehmen (zwingend) notwendig/wünschenswert sind?

Wie sehen Sie die Tauglichkeit des Chatbots für einen Unternehmenseinsatz? Können Sie sich vorstellen, den Chatbot in Ihrem Unternehmen einzusetzen? Wenn nein, was spricht gegen einen Einsatz?

Wie sehen Sie allgemein den Einsatz von Chatbots für Unternehmensprozesse?

Welche positiven/negativen Auswirkungen sehen Sie bei dem Einsatz des Chatbots?

Sehen Sie weitere Einsatzbereiche von Chatbots im Unternehmensalltag? Wie denken Sie, wird sich der Einsatz von Chatbots in Zukunft entwickeln?

Figure 91 Appendix 6.6 – Structured Interview Guideline - Page 3

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BLOCK 3: GESPRÄCHSABSCHLUSS

[Einleitung:] *Vielen Dank für die Möglichkeit die Evaluation mit Ihnen durchzuführen. Wir haben hiermit das Ende des Interviews erreicht.*

Abschließende Anmerkungen:

- Gibt es abschließend etwas, was Sie gerne noch ansprechen möchten?

[Tonaufnahme beenden!]

- Da wir auch gerne die Seite der zukünftigen/tatsächlichen Nutzer untersuchen würden, haben Sie vielleicht Ansprechpartner in Ihrem Unternehmen die wir dazu gesondert befragen können?

- Haben Sie Interesse an den Forschungsergebnissen? Wenn ja, stellen wir Ihnen diese gerne nach Abschluss der Studie bereit.

Danksagung und Verabschiedung

Figure 92 Appendix 6.6 – Structured Interview Guideline - Page 4

A6.7 Detailed User Experience Questionnaire Evaluation

Items: Current Form

Item	Left	Right	Scale	N	Mean	Std. Dev.
1	annoying	enjoyable	Attractiveness	35	-0,629	1,215
2	not understandable	understandable	Perspicuity	35	0,200	1,431
3	creative	dull	Novelty	35	-1,571	1,399
4	easy to learn	difficult to learn	Perspicuity	35	0,143	1,438
5	valuable	inferior	Stimulation	35	-0,171	1,150
6	boring	exciting	Stimulation	35	-1,657	1,413
7	not interesting	interesting	Stimulation	35	-1,457	1,442
8	unpredictable	predictable	Dependability	35	0,457	1,245
9	fast	slow	Efficiency	35	-0,914	1,147
10	inventive	conventional	Novelty	35	-2,086	0,951
11	obstructive	supportive	Dependability	35	-0,200	1,256
12	good	bad	Attractiveness	35	-0,343	1,162
13	complicated	easy	Perspicuity	35	-0,543	1,358
14	unlikable	pleasing	Attractiveness	35	-0,714	1,073
15	usual	leading edge	Novelty	34	-2,176	1,114
16	unpleasant	pleasant	Attractiveness	35	-0,771	1,140
17	secure	not secure	Dependability	35	0,314	1,323
18	motivating	demotivating	Stimulation	35	-1,543	1,172
19	meets expectations	does not meet expectations	Dependability	35	0,829	1,465
20	inefficient	efficient	Efficiency	35	-0,429	1,461
21	clear	confusing	Perspicuity	35	-0,457	1,578
22	impractical	practical	Efficiency	35	-0,200	1,368
23	organized	cluttered	Efficiency	35	-0,714	1,467
24	attractive	unattractive	Attractiveness	35	-1,286	1,073
25	friendly	unfriendly	Attractiveness	35	-0,829	1,224
26	conservative	innovative	Novelty	35	-2,229	1,003

Table 57 Appendix 6.7 – Detailed UEQ Results: Items Current Form

Constructs and Scale Consistency: Current Form

Item	Scale	N	Mean	Std. Dev.	Cronbachs Alpha-Coefficient	Guttmans Lambda2-Coefficient
1	Attractiveness	35	-0,762	0,94	0,92	0,92
2	Perspicuity	35	-0,164	1,43	0,85	0,84
3	Efficiency	35	-0,564	1,08	0,76	0,77
4	Dependability	35	0,350	0,90	0,69	0,68
5	Stimulation	35	-1,207	1,23	0,87	0,88
6	Novelty	35	-2,010	0,79	0,82	0,80

Table 58 Appendix 6.7 – Detailed UEQ Results: Constructs and Scale Consistency Current Form

Items: Chatbot

Item	Left	Right	Scale	N	Mean	Std. Dev.
1	annoying	enjoyable	Attractiveness	66	1,909	0,940
2	not understandable	understandable	Perspicuity	66	2,106	0,879
3	creative	dull	Novelty	66	1,318	1,179
4	easy to learn	difficult to learn	Perspicuity	66	2,394	0,742
5	valuable	inferior	Stimulation	66	1,742	0,847
6	boring	exciting	Stimulation	66	1,091	0,779
7	not interesting	interesting	Stimulation	66	1,409	0,841
8	unpredictable	predictable	Dependability	66	1,045	1,221
9	fast	slow	Efficiency	66	1,500	1,206
10	inventive	conventional	Novelty	66	1,439	1,191
11	obstructive	supportive	Dependability	66	1,924	1,012
12	good	bad	Attractiveness	65	2,123	0,893
13	complicated	easy	Perspicuity	66	1,894	1,010
14	unlikable	pleasing	Attractiveness	65	0,985	1,068
15	usual	leading edge	Novelty	66	1,773	1,064
16	unpleasant	pleasant	Attractiveness	66	1,576	1,096
17	secure	not secure	Dependability	66	1,409	1,289
18	motivating	demotivating	Stimulation	66	1,439	0,994
19	meets expectations	does not meet expectations	Dependability	64	1,313	1,167
20	inefficient	efficient	Efficiency	66	1,682	1,025
21	clear	confusing	Perspicuity	66	1,864	1,094
22	impractical	practical	Efficiency	66	1,576	1,138
23	organized	cluttered	Efficiency	66	1,833	1,284
24	attractive	unattractive	Attractiveness	64	1,375	0,968
25	friendly	unfriendly	Attractiveness	65	1,508	1,017
26	conservative	innovative	Novelty	66	1,924	0,933

Table 59 Appendix 6.7 – Detailed UEQ Results: Items Chatbot

Constructs and Scale Consistency: Chatbot

Item	Scale	N	Mean	Std. Dev.	Cronbachs Alpha-Coefficient	Guttmans Lambda2-Coefficient
1	Attractiveness	66	1,585	0,53	0,82	0,82
2	Perspicuity	66	2,064	0,59	0,84	0,83
3	Efficiency	66	1,648	0,91	0,83	0,83
4	Dependability	66	1,431	0,75	0,72	0,72
5	Stimulation	66	1,420	0,43	0,76	0,76
6	Novelty	66	1,614	0,77	0,82	0,81

Table 60 Appendix 6.7 – Detailed UEQ Results: Constructs and Scale Consistency Chatbot

A6.8 Detailed Acceptance Evaluation

Information Quality

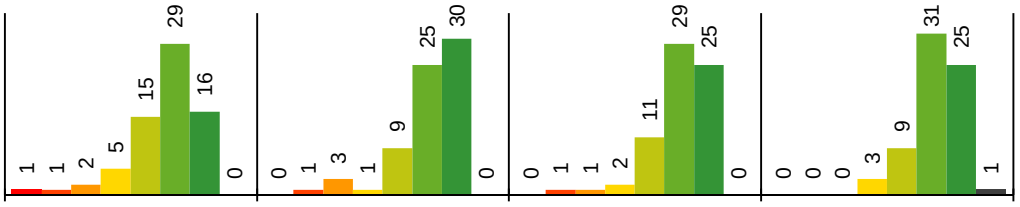

Figure 93 Appendix 6.8 – Detailed Distribution: Information Quality

Service Quality

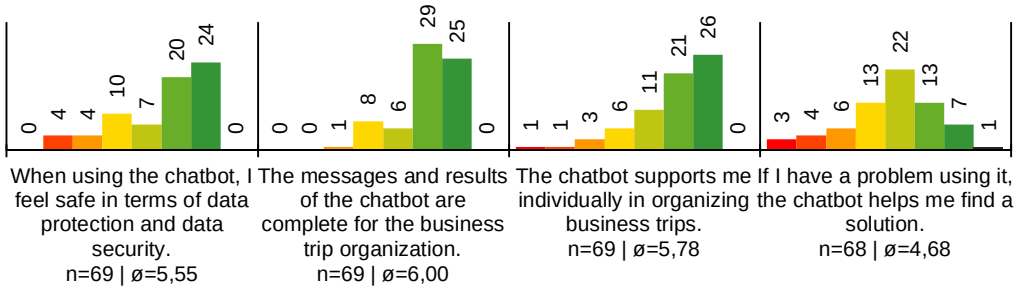

Figure 94 Appendix 6.8 – Detailed Distribution: Service Quality

Perceived Usefulness

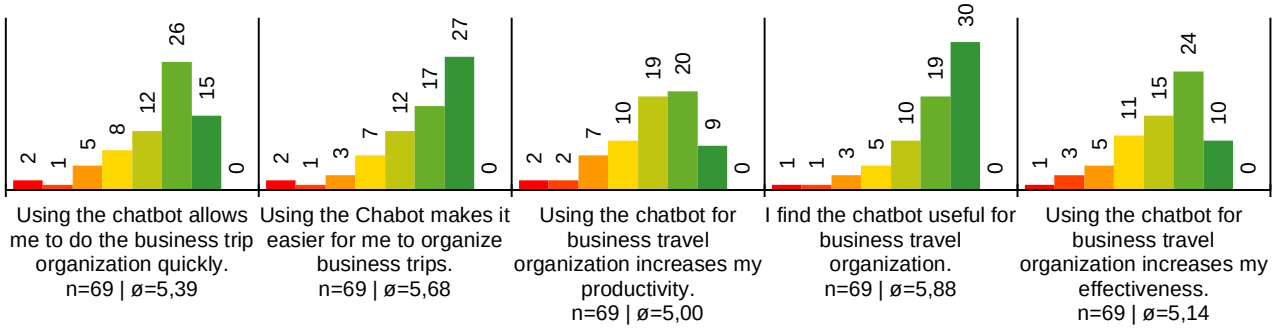

Figure 95 Appendix 6.8 – Detailed Distribution: Perceived Usefulness

Perceived Ease of Use

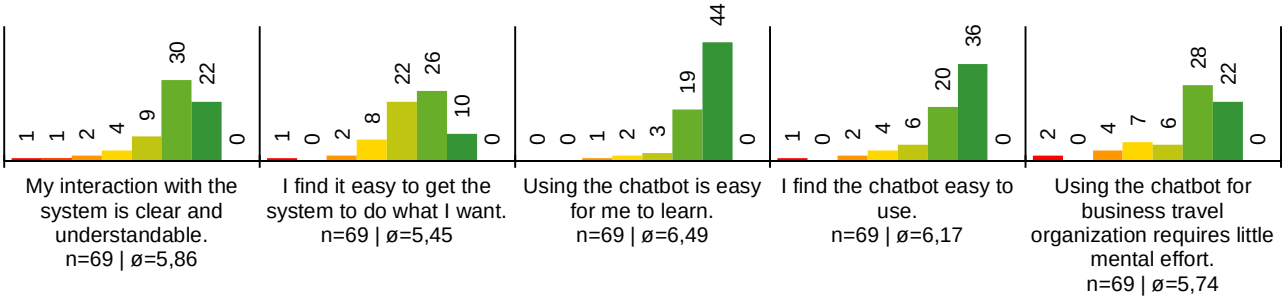

Figure 96 Appendix 6.8 – Detailed Distribution: Perceived Ease of Use

Behavioral Intention to Use

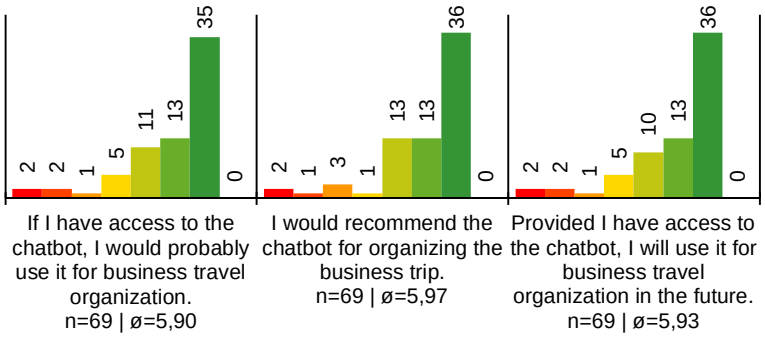

Figure 97 Appendix 6.8 – Detailed Distribution: Behavioral Intention to Use

User Satisfaction

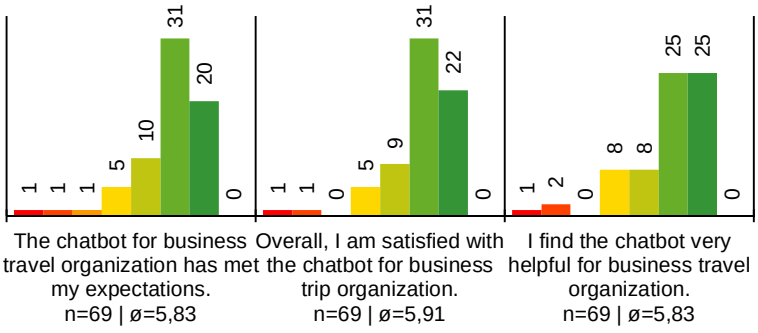

Figure 98 Appendix 6.8 – Detailed Distribution: User Satisfaction

A7 Procedure Model for Chatbot Introduction and Operation

A7.1 1st Iteration Procedure Model

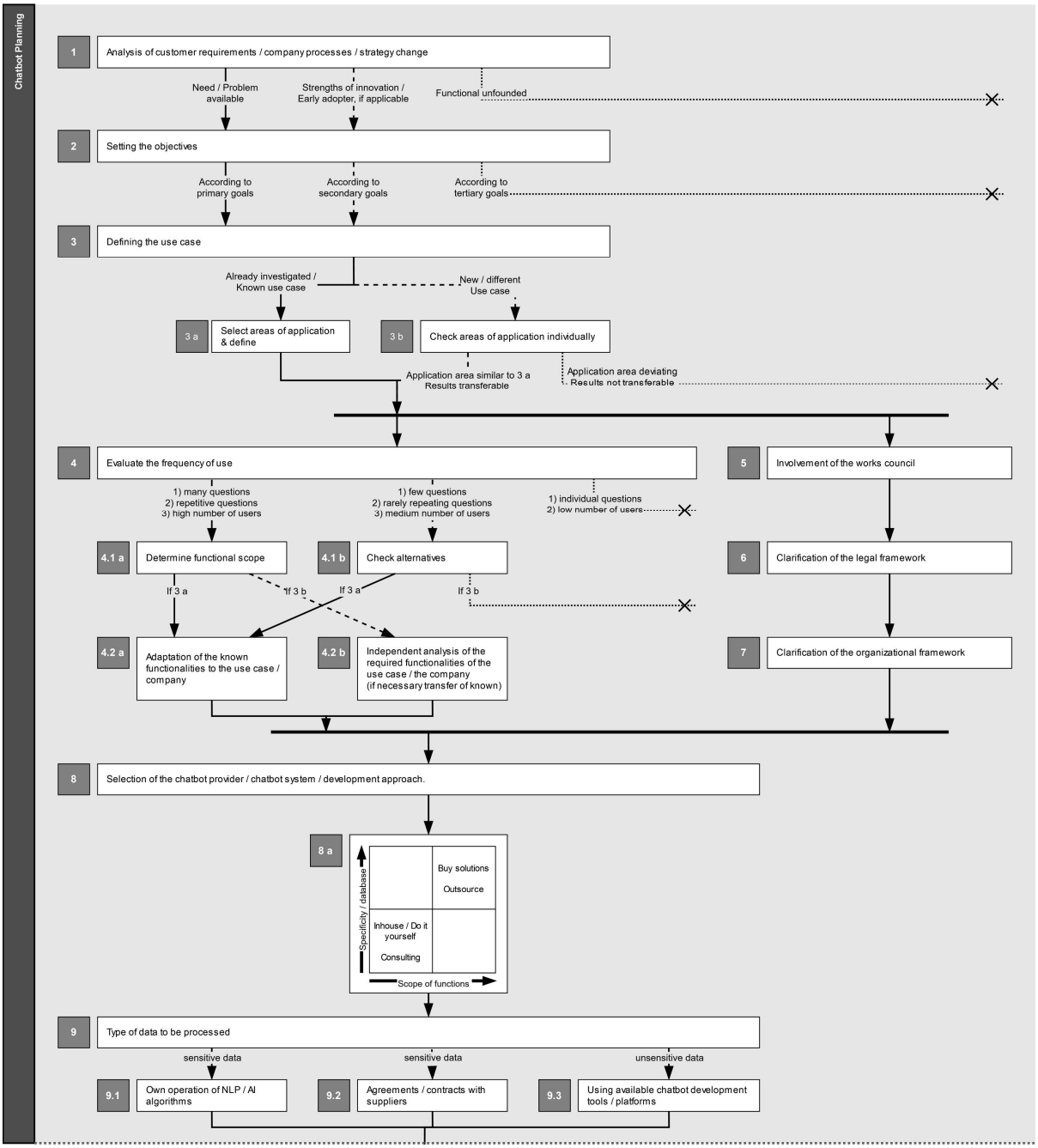

Figure 99 Appendix 7.1 – 1st Iteration Procedure Model I

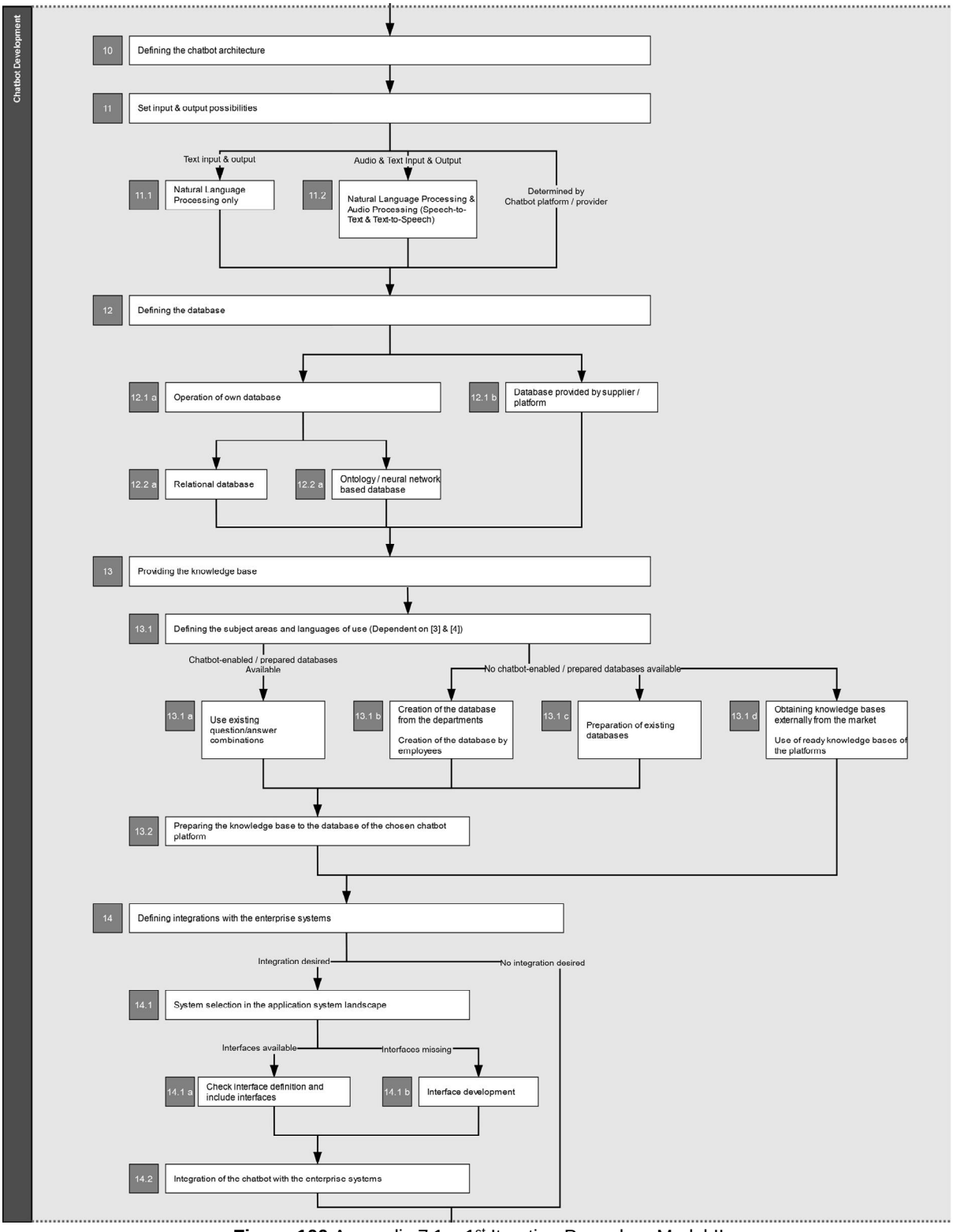

Figure 100 Appendix 7.1 – 1st Iteration Procedure Model II

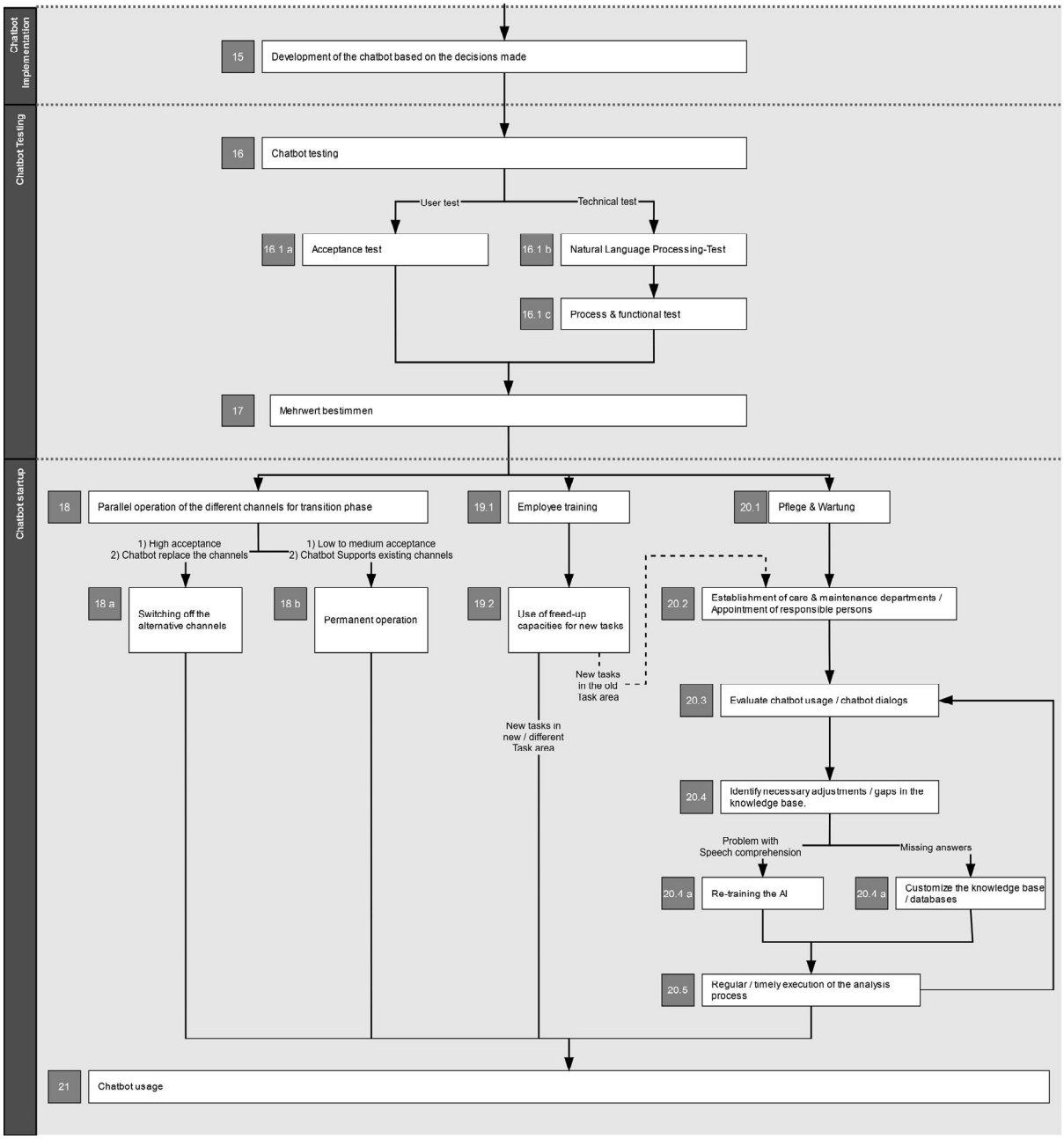

Figure 101 Appendix 7.1 – 1st Iteration Procedure Model III

A7.2 2nd Iteration Procedure Model

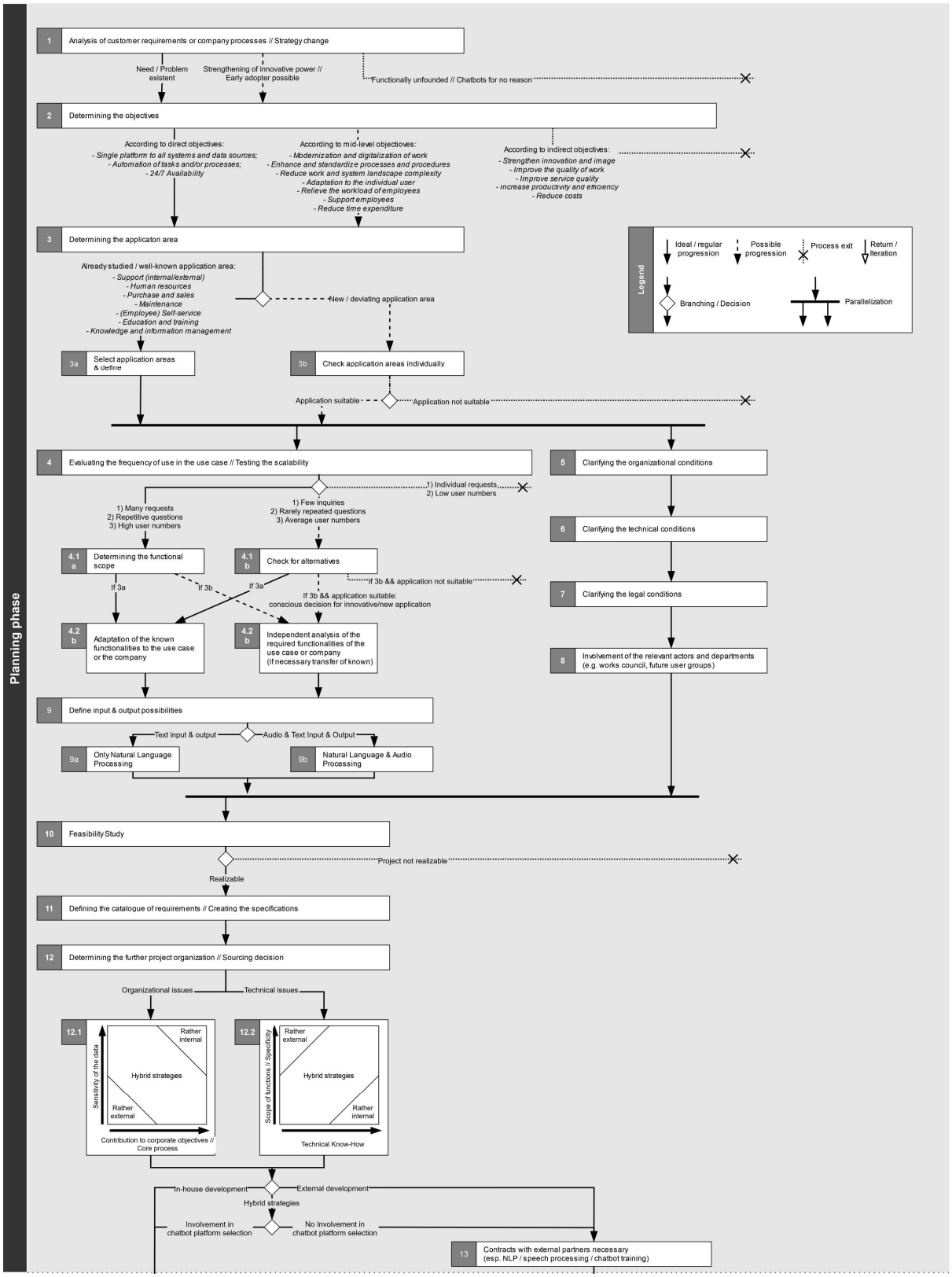

Figure 102 Appendix 7.2 – 2nd Iteration Procedure Model I

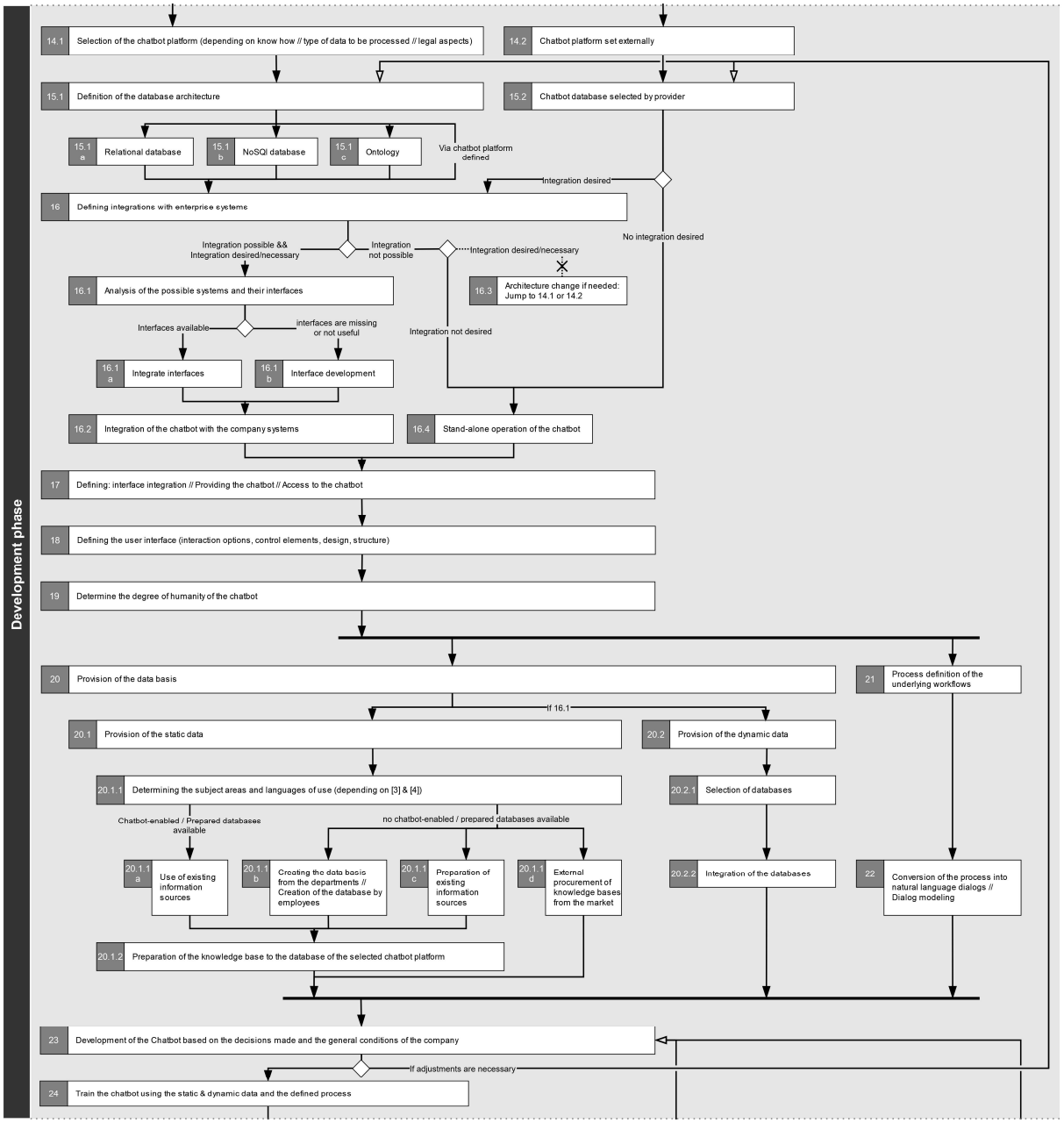

Figure 103 Appendix 7.2 – 2nd Iteration Procedure Model II

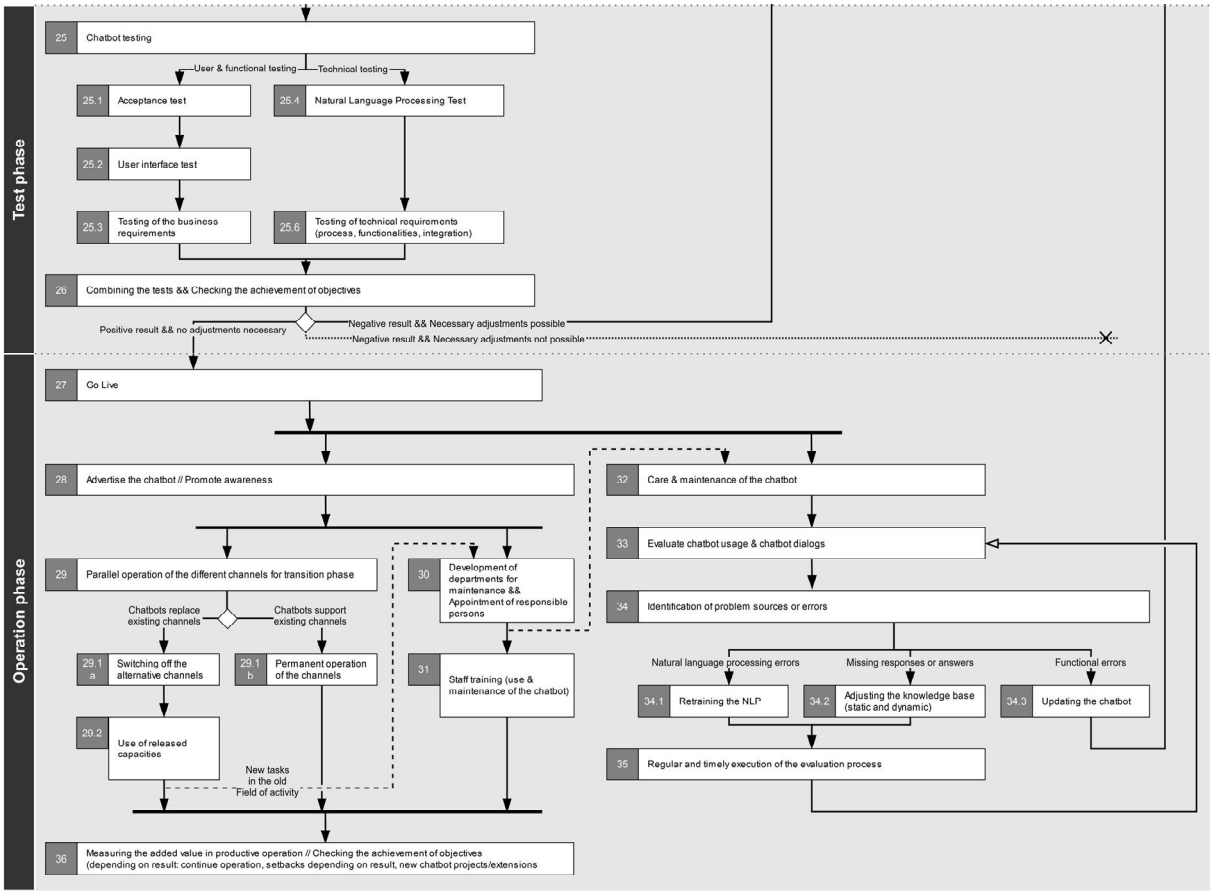

Figure 104 Appendix 7.2 – 2nd Iteration Procedure Model III

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Overview of the Author Shares on the Conducted Studies

Complex A	**Study I**	(Meyer von Wolff et al. 2019a)	**State of the Art and Research Relevance**	***HICSS 2019***
		Authors: **Meyer von Wolff, R. 90 %** Hobert, S. 5 % Schumann, M. 5 %	***How May I Help You? – State of the Art and Open Research Questions for Chatbots at the Digital Workplace*** **Main Contribution:** Structured literature review to examine the research relevance. Identifying current research contributions, potentials, and objectives.	
	Study II	(Meyer von Wolff et al. 2020a)	**State of the Practice on Application Areas and Objectives**	***PAJAIS 2020***
		Authors: **Meyer von Wolff, R. 80 %** Hobert, S. 10 % Masuch, K. 5 % Schumann, M. 5 %	***Chatbots at Digital Workplaces – A Grounded-Theory Approach for Surveying Application Areas and Objectives*** **Main Contribution**: Qualitative empirical cross-section interview study with experts for chatbot adoption and workplace design. Surveying usage scenarios, application areas, and objectives of chatbots at digital workplaces based on a grounded-theory process	
	Study III	(Meyer von Wolff et al. 2021b)	**State of the Practice on Influencing Factors and Challenges**	***WI 2021***
		Authors: **Meyer von Wolff, R. 90 %** Hobert, S. 5 % Schumann, M. 5 %	***Sorry, I Can't Understand You! – Influencing Factors and Challenges of Chatbots at Digital Workplaces*** **Main Contribution**: Qualitative empirical cross-section interview study with experts for chatbot adoption and workplace design. Surveying Influencing factors and challenges concerning chatbot adoption and application in workplace scenarios.	
Complex B	**Study IV**	(Meyer von Wolff et al. 2020b)	**Requirements Analysis for Information Acquisition Chatbots**	***Conversations 2019***
		Authors: **Meyer von Wolff, R. 80 %** Nörtemann, J. 10 % Hobert, S. 5 % Schumann, M. 5 %	***Chatbots for the Information Acquisition at Universities – A Student's View on the Application Area*** **Main Contribution**: Qualitative and quantitative questionnaire study to examine students' technical and content-related requirements of chatbots for information acquisition tasks in the university context.	
	Study V	(Meyer von Wolff et al. 2020d)	**User Acceptance for IT-Support Chatbots**	***AMCIS 2020***
		Authors: **Meyer von Wolff, R. 80 %** Heuzeroth, T. 10 % Hobert, S. 5 % Schumann, M. 5 %	***The Students' View on IT-Support Chatbots at Universities – A Case-based Pilot Study*** **Main Contribution**: Design, development, and evaluation of a chatbot for IT-support tasks with three test scenarios that differ in scope and provided visualization. Survey of the users' perspective and usability of the chatbot.	
	Study VI	(Meyer von Wolff et al. Forthcoming)	**Process-based Chatbots for Business Processes**	***AIS THCI (under review)***
		Authors: **Meyer von Wolff, R. 85 %** Hobert, S. 10 % Schumann, M. 5 %	***Designing Process-based Chatbots in Enterprises: The case of Business Travel Organization considering the Users' Perspective and Business Value*** **Main Contribution**: Design, development of the process-based chatbot Spot. Evaluation in terms of users' and organizational perspective based on a laboratory experiment with three participant groups based on a quantitative and qualitative questionnaire and expert interviews. Proposal of a nascent design theory for process-based chatbots at digital workplaces	
Complex C	**Study VII**	(Meyer von Wolff et al. 2022a)	**Procedure Model for Chatbot Projects in Business**	***HICSS 2022***
		Authors: **Meyer von Wolff, R. 85 %** Hobert, S. 10 % Schumann, M. 5 %	***Chatbot Introduction and Operation in Enterprises – A Design Science Research-based Structured Procedure Model for Chatbot Projects*** **Main Contribution**: Design and evaluation of the chatbot procedure model for the introduction and operation of chatbots in businesses.	

Göttingen, 06.06.2022

Raphael Meyer von Wolff

Declaration for Admission to the Doctoral Examination: Ph.D. Program in Economics

I confirm,

1. that the dissertation that I submitted „*The Application of Chatbots at the Digital Workplace in Businesses – Empirical Insights and Design Recommendations for Business Chatbots*“ that I submitted was produced independently without assistance from external parties, and not contrary to high scientific standards and integrity,
2. that I have adhered to the examination regulations, including upholding a high degree of scientific integrity, which includes the strict and proper use of citations so that the inclusion of other ideas in the dissertation are clearly distinguished,
3. that in the process of completing this doctoral thesis, no intermediaries were compensated to assist me neither with the admissions or preparation processes, and in this process,
    - no remuneration or equivalent compensation were provided
    - no services were engaged that may contradict the purpose of producing a doctoral thesis
4. that I have not submitted this dissertation or parts of this dissertation elsewhere.

I am aware that false claims (and the discovery of those false claims now, and in the future) with regards to the declaration for admission to the doctoral examination can lead to the invalidation or revoking of the doctoral degree.

Göttingen, 06.06.2022

Raphael Meyer von Wolff