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Tackling the IT Skills Shortage: Different Paths in a Difficult Terrain

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Preface

A dissertation is no lonely journey, at least not for me. Along the way, I have crossed paths with many people who have shaped my thinking, supported, encouraged, and challenged me, and without whom this dissertation would not have been possible.

I owe them all a huge debt of gratitude. I thank all my coauthors for their dedication, my mentors for their guidance, my colleagues for making this fun, my friends for providing much-needed distraction, and my family for their unconditional support. While they all helped me with this journey, I am especially indebted to the following people:

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Abstract

Problem Statement

The Information Technology (IT) skills shortage is an ongoing problem that has troubled practitioners and researchers for years. As digitalization advances, the landscape is expected to become even more severe. Research and companies need to cooperate in developing new approaches to combat the ongoing shortage of IT professionals.

Research Design

This thesis investigates different approaches to tackling the IT skills shortage. In research question one, we examine the mindset of young IT professionals and provide insights into how companies can attract them. Research question two investigates how key IT professionals can be retained in companies. In research question three, we explore alternative approaches to the IT job market, namely the integration of boundaryless IT professionals into companies. Adopting a post-positivist perspective, we conducted quantitative and mixed studies to test these three approaches.

Results

The results of research question one present a modern picture of the career expectations of young IT professionals. We show how prospective IT professionals define current career success based on a balance of contrasting career success factors. Furthermore, we describe educational measures that lead early IT professionals to stay in the IT sector for the long term. Finally, we introduce IT professionals with a boundaryless mindset and provide recommendations on how they can best be deployed in organizations.

Research question two demonstrates how work practices, work environments, training, and context affect IT professionals and their career mobility behavior. We illustrate how agile practices can reduce turnover intention by improving organizational commitment. Furthermore, we discuss the ambiguous effects of training on career mobility by simultaneously increasing and decreasing the risk of quitting in the IT context. Finally, we use the example of the COVID-19 pandemic to show how contextual change as an external shock can alter the career mobility behavior of IT professionals rapidly and forcefully.

Research question three shows the potential of boundaryless IT professionals in the IT labor market. In particular, we examine boomerang IT professionals who return after having left the IT sector and outline their benefits for companies. Furthermore, we study late-entry IT professionals who enter the IT sector after gaining work experience in other occupations and show that only a small fraction of this group has remained in the IT industry long-term. Based on this finding, we deduce recommendations on how boundaryless IT professionals must be appropriately selected and integrated into organizations.

We summarize our findings in a graphic synthesis that explains the interplay of the three research questions and their results.

Contribution

This dissertation makes numerous connections to existing research by confirming, extending, and contextualizing Information Systems (IS), IT, and Human Resources (HR) theories. Furthermore, we provide practical implications for companies to tackle the shortage of IT professionals. Concerning practical contribution, the collected studies show ways to attract, advance, and retain IT professionals in the long term. Furthermore, the dissertation provides guidelines on integrating boundaryless IT professionals in the IT sector. In terms of theoretical contribution, this dissertation expands our theoretical understanding of human resource management (HRM) in IT by extending research on the specifics of IT professionals, recruitment of IT professionals, IT careers and turnover, boundaryless careers, and contextual change in an IT context.

Limitations

The limitations of this thesis relate to the scope of the dissertation, the choice of research methodology and research perspective according to the post-positivism paradigm. We acknowledge that limiting the scope of the dissertation to the chosen research questions might have resulted in missing potentially important issues and influences related to the career mobility of IT professionals. Furthermore, the chosen perspective of a post-positive paradigm and the selection of quantitative research methodology may have limited our ability to identify unobserved influences in models that could observe, for example, through a qualitative approach. Following this line of thought, the operationalization of variables, particularly in archival data, can significantly impact the results of analyses and must be considered accordingly. Finally, we would like to point out that our studies have national contexts (Germany & USA & UK), which may have influenced our results.

Future Research

Future research may address the limitations of this dissertation. In addition, this dissertation offers many directions for further research, three of which we would like to highlight: 1) Future researchers should study factors that help IT professionals build resilience during challenging times. 2) We recommend a detailed examination of the coming generations of IT professionals and their new ways of working, amplified and accelerated by the COVID-19 crisis. It is expected that the global, location-independent recruitment of IT professionals, as well as working from home, will bring significant changes to employees' career mobility. 3) Researchers should examine the potential of late-entry IT professionals to better understand what drives this group into IT and what makes their career transitions successful or unsuccessful.

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List of Abbreviations

ACM	Association for Computing Machinery
BLS	US Bureau of Labor Statistics
CB-SEM	Covariance-based Structural Equation Modeling
CPR	ACM SIGMIS Conference on Computers and People Research
CSF	Career Success Factor
DV	Dependent Variable
ECIS	European Conference on Information Systems
HR	Human Resources
HRM	Human Resource Management
ICIS	International Conference on Information Systems
ISD	Information Systems Development
IS	Information Systems
IT	Information Technology
IV	Independent Variable
NLSY97	The National Longitudinal Survey of Youth 1997
PLS-SEM	Partial Least Squares Structural Equation Modeling
RQ	Research Question
SEM	Structural Equation Modeling
SIGMIS	Special Interest Group on Management Information Systems
SME	Small and medium enterprises
WI	Internationale Tagung Wirtschaftsinformatik
SOEP	German Socio-Economic Panel
US	United States of America

Part A
Introduction and Background

1 Introduction

1.1 Motivation

The rapid progress of digitalization and the increasing use of technology in companies have caused the number of Information Technology (IT) job vacancies to rise constantly for years worldwide (Wiesche et al., 2020). In the US, the demand for IT project managers is expected to increase by 16% between 2021 and 2031 (Bureau of Labor Statistics, 2022a), which equates to 82,400 new positions for IT managers. For software developers, the demand is expected to increase by as much as 25%, corresponding to 411,400 new jobs (Bureau of Labor Statistics, 2022b). In Germany, despite the remaining influences of the economic recession caused by the COVID-19 crisis, 137,000 IT jobs remained unfilled in 2022 (Bitkom, 2022). These high numbers of IT job vacancies and their expected increase indicate that companies need to fight for talented IT staff in the competitive IT job market and might face even more challenging battles to hire new staff in the future.

The battle to recruit and retain skilled IT professionals is further exacerbated by the high turnover rates in the IT sector (Zaza et al., 2023). Reviews of studies on turnover (i.e., voluntary leaving of a company) in IT point to numerous antecedents of career mobility in IT, such as perceived skill obsolescence, role conflict, or a lack of supervisor support (Joseph et al., 2007; Zaza et al., 2023). However, these reviews highlight two characteristics of IT work in particular: IT work is notoriously demanding work in a labor market constantly short of skilled workers. This combination of demanding work and a high number of job alternatives significantly lowers the switching costs for IT professionals. It, therefore, makes it exceedingly easy for them to leave their employers. In this environment, even single events (see the concept of shocks in the Unfolding Model of Voluntary Turnover (Lee et al., 1999)) can trigger impulsive turnover (Maier et al., 2021; Niederman et al., 2007). To reduce high turnover rates in IT, we need to understand how to retain IT professionals in this dynamic environment in the long term.

Besides frequent fluctuation, rapid technological progress makes the IT profession frequently exposed to change (Joseph et al., 2012; Niederman et al., 2016). The boundaries between IT professionals and other professions might blur with increased digital work. The next generation of IT professionals further embraces a modern mindset toward career development, which opens the door to contemporary career models (Hirschi & Koen, 2021). Consequently, the IT profession has been described as evolving into a boundaryless profession, in which individuals seem to be bound neither to their organization nor their occupation (Gubler, 2011; Joseph et al., 2012). Hence, IT skills shortages are exacerbated because IT professionals show not only a propensity to change their employers but also their profession.

Due to the ongoing IT skills shortage, the high turnover rate in IT, and the expected rise of boundaryless careers in IT, it will be all the more important in the future to develop new approaches to hiring and retaining a skilled IT workforce in this highly dynamic environment. To be able to compete in the highly contested IT job market, companies need to address three issues:

1) Attracting the next generation of IT professionals.

2) Retaining skilled key IT professionals.

3) Evaluating alternative approaches to fill vacant IT positions.

With this thesis, we address these issues by broadly investigating the following research question:

How can companies hire and retain a skilled IT workforce in a highly dynamic environment?

By addressing this question, we can provide recommendations on how to fill IT job vacancies with skilled personnel and how to keep this personnel over the long term. To do so, we investigate the career decisions of young and prospective IT professionals (RQ1), examine how companies can retain their IT staff in a dynamic work environment (RQ2), and evaluate alternative ways of filling IT positions in companies (RQ3).

This dissertation is designed as a publication-based thesis, meaning that answers to the research questions will be presented in the form of scientific publications in Information Systems (IS) conference proceedings and in IS journals. We answer all three research questions across eight papers, which will be introduced in Part B. With this dissertation, we contribute to a better understanding of the future of the IT workforce and provide suggestions to tackle the need for more skilled IT workers in companies.

1.2 Research Questions

In the following section, we explain the aim of this dissertation in more detail by introducing three research questions and their respective research approach. To highlight the practical relevance of this dissertation, we illustrate the three research questions with three challenges that companies must overcome in the IT job market. We answer the three research questions across a total of eight papers. An overview of the studies can be found in Table 1.

Challenge No. 1: Attracting the next generation of IT professionals

Due to high turnover rates, companies must continuously recruit new IT professionals. Changes in the job market can be seen in the following contexts: First, the rapid development of technology leads to a broader and more diverse profile of IT professionals with fewer boundaries regarding companies and occupational types (Joseph et al., 2012). This opens the possibility of more boundaryless careers in the IT sector (i.e., careers with flexible changes between employers and professions (Arthur, 1994)). Second, young professionals show divergent career decision-making patterns (Guan et al., 2019; Suleman & Nelson, 2011). Whereas traditional career anchors, such as stability, are losing importance, young IT professionals now desire flexibility, challenge, and experience (Chang et al., 2012). In a world full of job alternatives, further changes in the decisive factors influencing the choice for or against employers is to be expected (Thatcher et al., 2012).

For companies, the question now arises as to how they can emphasize their attractiveness as an employer for the next generation of IT professionals. However, only little is known about the

career decisions of IT graduates and young IT professionals in their early career stages (Deng et al., 2023; Setor & Joseph, 2021; Thatcher et al., 2012). Since the next generation of IT professionals is crucial for covering the imminent IT skills shortage, an investigation of contemporary career concepts amongst young IT professionals is promising. Drawing on the theory of boundaryless careers, we explore the expectations and intentions of prospective and early-career IT professionals regarding their future careers. Thus, we investigate the following research question (RQ):

RQ1: How can companies attract young IT professionals who pursue contemporary career concepts?

Research Approach: To answer RQ1, we will adopt a mixed-method approach (Venkatesh et al., 2013) by investigating publicly available data sets and surveying prospective and young IT professionals. First, we analyze a public data set, the National Longitudinal Survey of Youth (NLSY97) (US. Bureau of Labor Statistics, 2021). This data set represents annual surveys of young men and women in the United States of America (US) and provides information about their personal and professional development. Based on the observations from the dataset, we afterward conducted surveys with IT students to find out about personal expectations of their future careers, to what extent they follow boundaryless career attitudes, and how they influence future career planning in IT. The output of this research question is three studies: 1) one study on the career decisions of young IT professionals based on US American socio-economic panel data; 2) one study on the perceived (future) career success of current IT students in Germany and 3) one study of the boundaryless career attitudes of young IT professionals and their influence on career plans in IT. Together, these three publications yield an informative overall picture of the next generation of IT professionals from different perspectives.

Challenge No. 2: Retaining skilled key IT professionals

The high risk for turnover poses significant challenges to IT companies, especially with retaining highly skilled IT workers. Besides the difficult task of filling open IT vacancies, the turnover of employees in companies leads to high replacement costs. In addition to the obvious direct costs, such as staffing costs for the hiring process or temporary coverage for projects, there are also high indirect costs, such as onboarding measures for new employees (Allen et al., 2010; Mitchell, Holtom, & Lee, 2001). Therefore, companies must find ways to retain skilled IT talent long-term (Pflügler et al., 2018; Zylka & Fischbach, 2017).

To keep IT professionals in companies, we first need to understand the triggers of turnover for IT professionals. Studies on the turnover of IT professionals describe the dynamic working environment, the demanding job characteristics, and a lack of training and advancement opportunities as the main influence factors for turnover decisions of IT professionals (Joseph et al., 2007; Zaza et al., 2023). In addition, the high job rotation in the IT industry enables IT professionals to make quick turnover decisions, providing the perfect breeding ground for so-called shock events to take effect (Holtom & Inderrieden, 2006; Lee & Mitchell, 1994). Single jarring events in an employee's life, such as an argument with a colleague, have proven to be very influential in the IT industry and can cause IT professionals to leave their job (Maier et al., 2021; Niederman et al., 2007). While we have made great strides in researching turnover

triggers in IT, we still need to learn how to buffer these triggers and retain key IT professionals for the long term. Therefore, we investigate the following research question:

RQ2: How can companies prevent the turnover of highly qualified IT professionals in a dynamic work environment?

Research Approach: For answering RQ2, we adopt a quantitative and theoretical method approach and investigate the influence of agile practices, training possibilities, and crisis management on the career mobility of IT professionals. First, we investigate how agile practices affect the organizational commitment of IT professionals utilizing a survey of agile software development teams. Next, we create a theoretical framework on the dualism effect of training on the turnover decisions of IT professionals. Finally, we present findings on how the COVID-19 pandemic as an external shock suddenly affected the career mobility decisions of IT professionals in Germany and how crisis management helps reduce turnover intention in times of change. The outcome of this research question is three publications: 1) a study on the influence of agile practices on the turnover behavior of IT professionals, 2) a paper on the effects of training on the turnover intention of IT professionals, 3) a study on the turnover behavior of IT professionals in a highly dynamic context, using the COVID-19 pandemic as an example.

Challenge No 3: Evaluating alternative approaches to fill vacant IT positions

The current fast digitalization is reflected in the evolving IT profession and its changing areas of expertise. If more jobs are based digitally in the future, the boundaries between IT professionals and other professions might blur. Consequently, the IT profession has been described as a boundaryless profession (Joseph et al., 2012), meaning that employees in IT are neither bound to their organization nor their discipline. The high level of job security, the many job alternatives (Joseph et al., 2007), and the increase in management and soft skills requirements in IT (Gallivan et al., 2004) have made the IT profession a broader professional field.

This development will open opportunities for new occupational groups to gain a foothold in IT. This change can be observed in the IT market through two phenomena: first, employees without an IT background (so-called late-entry IT professionals) are increasingly conquering IT jobs (Prommegger, Weinert, et al., 2020); second, IT professionals who have turned away from the IT sector are switching back to IT later in their careers, following the principles of so called-boomerang careers (Maier et al., 2021; Swider et al., 2017). While much IT workforce literature deals with why IT professionals leave IT, there needs to be more literature on individuals finding their way into or returning to IT. To understand whether late-entry and boomerang IT professionals represent a practical, alternative way for companies to combat the IT skills shortage, we investigate the following research question:

RQ3: Which alternative ways to fill vacant IT positions benefit companies and employees?

Research Approach: To understand the careers of boundaryless IT professionals, we investigate German socio-economic panel (SOEP) data (Goebel et al., 2019). The SOEP is a representative survey of the German population that has been conducted annually since 1984. The survey

covers questions on individuals' work and private lives and thus presents a perfect foundation to investigate career paths over time. By applying sequence analysis, we map careers and examine them for similarities using cluster analysis (Chan, 1995). Based on these analyses, we examine the careers of late-entry and boomerang IT professionals and evaluate how companies can best employ them to address the IT skills shortage. The output of this research question is two Germany-based studies: 1) one study on late-entry IT professionals, and 2) one study on boundaryless IT professionals.

1.3 Structure

This dissertation is composed of three parts. In Part A, we describe the motivation of the dissertation, present the research questions, and introduce the theoretical foundations of the dissertation. Part B contains the publications on which the dissertation is founded. In Part C, we summarize and discuss the results of the publications and give an overview of the theoretical and practical implications. Furthermore, we provide insights into the limitations of the studies and present a research agenda for future research. Figure 1 provides an overview of the structure and context of the work.

Part A lays the theoretical foundation of the dissertation and consists of three sections: 1) Introduction, 2) Theoretical Background, and 3) Research and Methodological Approach. In Part A, we describe the motivation for the dissertation, as well as our research questions. We also provide insights into the theoretical concepts that build the foundation of this thesis and describe the research methodologies and approaches that guided us through this dissertation.

In Part B, we present the eight dissertation publications. Table 1 gives an overview of the included publications. Publications 1, 2, and 3 contribute to answering RQ1. In *Publication 1 (P1)*, we describe young IT professionals' early career patterns and career decisions. In *Publication 2 (P2)*, we introduce different perspectives on the perceived career success of the next generation of IT professionals. In *Publication 3 (P3)*, we explain how boundaryless IT professionals will move in the IT job market in the future and how organizations can best hire them. Publications 4, 5, and 6 contribute to answering RQ2. In *Publication 4 (P4)*, we describe how agile practices increase the organizational commitment of IT professionals. In *Publication 5 (P5)*, we explain the dual outcome of training on the turnover behavior of IT professionals. In *Publication 6 (P6)*, we describe the importance of context and explain how contextual change affects the career mobility of IT professionals, using the example of the COVID-19 crisis. Publications 7 and 8 contribute to answering RQ3. In *Publication 7 (P7)*, we describe the career patterns and characteristics of late-entry IT professionals. In *Publication 8 (P8)*, we broaden our view by describing how boundaryless IT professionals move in the IT job market, and identifying similarities and differences between late-entry IT professionals, boomerang IT professionals, and IT leavers.

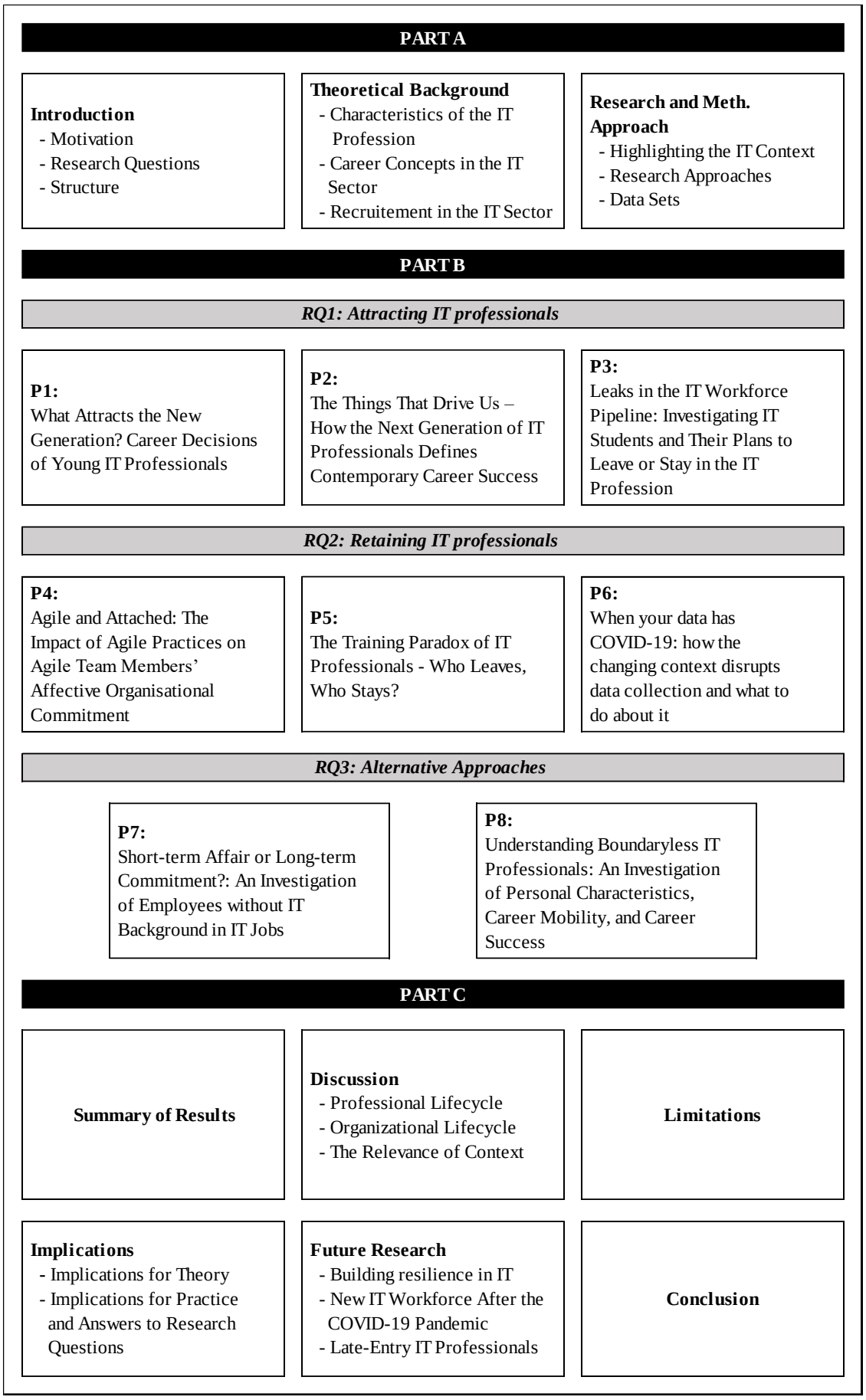

Figure 1: Structure of Thesis (Own Illustration)

Table 1: Overview of Published and Peer-Reviewed Publications Included in Thesis

No	Authors	Title	Outlet	Type (Ranking)*	RQ
P1	Prommegger, B. Intane, J. Wiesche, M. Krcmar, H.	What Attracts the New Generation? Career Decisions of Young IT Professionals	ECIS 2020	Conference (B)	RQ1
P2	Prommegger, B. Arpaci, S. Krcmar, H.	The Things That Drive Us – How the Next Generation of IT Professionals Defines Contemporary Career Success	WI 2022	Conference (C)	RQ1
P3	Prommegger, B. Arpaci, S. Krcmar, H.	Leaks in the IT Workforce Pipeline: Investigating IT Students and Their Plans to Leave or Stay in the IT Profession	ECIS 2022	Conference (B)	RQ1
P4	Prommegger, B. Huck-Fries, V. Wiesche, M. Krcmar, H.	Agile and Attached: The Impact of Agile Practices on Agile Team Members' Affective Organisational Commitment	WI 2019	Conference (C)	RQ2
P5	Prommegger, B. Wiesche, M. Thatcher, J. B. Krcmar, H.	The Training Paradox of IT Professionals-Who Leaves, Who Stays?	ICIS 2020	Conference (A)	RQ2
P6	Prommegger, B. Thatcher, J. B. Wiesche, M. Krcmar, H.	When your data has COVID-19: how the changing context disrupts data collection and what to do about it	EJIS	Journal (A)	RQ2
P7	Prommegger, B. Wendrich, M. Wiesche, M. Krcmar, H.	Short-term Affair or Long-term Commitment? An Investigation of Employees without IT Background in IT Jobs	CPR 2020	Conference (unranked)	RQ3
P8	Prommegger, B. Arshad, D. Krcmar, H.	Understanding Boundaryless IT Professionals: An Investigation of Personal Characteristics, Career Mobility, and Career Success	CPR 2021	Conference (unranked)	RQ3

Outlets	
CPR 2020	ACM SIGMIS Conference on Computers and People Research, 2020, Virtual
CPR 2021	ACM SIGMIS Conference on Computers and People Research, 2021, Virtual
ECIS 2020	28th European Conference on Information Systems, 2020, Virtual
ECIS 2022	30th European Conference on Information Systems, 2022, Timișoara, Romania
EJIS	European Journal of Information Systems
ICIS 2020	41st International Conference on Information Systems, Virtual
WI 2019	14. Internationale Tagung Wirtschaftsinformatik, 2019, Siegen, Germany
WI 2022	17. Internationale Tagung Wirtschaftsinformatik, 2022, Virtual

*according to VHB

Part C discusses the results of the dissertation and contains six sections: 12) Summary of Results, 13) Discussion, 14) Limitations, 15) Implications, 16) Potentials for Future Research, and 17) Conclusion. In the chapter Summary of Results, we give a summarized insight into the results of the dissertation. In the chapter Discussion, we discuss the results using a condensed illustration and put them into context with each other. We present the results of this dissertation based on two different perspectives levels (professional lifecycle, and organizational lifecycle) and discuss the role of context on the influences on attracting and retaining IT professionals in organizations and the IT sector. In the chapter Limitations, we report on the boundaries of the

dissertation and give suggestions on how to overcome them in the future. The chapter Implications first gives insight into the theoretical implications of the dissertation and points out how we extend the existing theory on hiring and retaining IT professionals. The section on Practical Implications answers our three research questions and provide recommendations for organizations on hiring and retaining IT professionals. In the chapter Potentials for Future Research, we present three research strands that have emerged particularly promising in our dissertation and suggest how to build on them through future research. In Conclusion, we provide final thoughts on the topic of the dissertation.

Throughout the last few years, the author of this thesis has worked on additional papers as a leading author, which are not included in the dissertation but still contribute to the context of the thesis. Table 2 provides an overview of these two additional papers. These are: a literature review on the specifics of the IT profession *(P9)*; and an examination of the impact of workplace social support on IT professionals' turnover intention during the COVID-19 crisis *(P10)*.

Table 2: Overview of Additional Publications Relevant to Thesis

No	Authors	Title	Outlet	Type (Ranking)	RQ
P9	Prommegger, B. Wiesche, M; Krcmar, H	What Makes IT Professionals Special? A Literature Review on Context-Specific Theorizing in IT Workforce Research	CPR2020	Conference (unranked)	RQ1, RQ2, RQ3
P10	Prommegger, B. Krcmar, H.	Through Good Times and Bad: The Influence of Workplace Social Support on IT Professionals' Turnover Intention during the COVID-19 Crisis	CPR2021	Conference (unranked)	RQ2
Outlets					
CPR 2020		ACM SIGMIS Conference on Computers and People Research, 2020, Virtual			
CPR 2021		ACM SIGMIS Conference on Computers and People Research, 2021, Virtual			

2 Theoretical Background

In this section, we discuss the literature constituting the basis of this dissertation. Specifically, we present literature on the characteristics of the IT profession, introduce career concepts in IT, and give an overview of recruitment in the IT profession.

2.1 Characteristics of the IT Profession

The high diversity in the IT sector and its involved tasks, responsibilities, and jobs results in need for a uniform definition of the IT profession and its entailed occupations and professions. Following the example of Davis and Olson (1985), IT work can be described as the discipline of "analysis, design, development, implementation, support, and management of computer-based information systems, composed of software, hardware, people, procedures, and data" (Goles et al., 2008, p. 179). In the context of this thesis, we will use the definition of IT professionals by Niederman et al. (2016): We describe IT professionals as "the workers who design, build, and manage application systems, who introduce them and other related IT into organizational environments, who operate, maintain, extend, and manage the IT, and who provide training, documentation, and support […]" (Niederman et al., 2016, p. 29). In the following, we introduce literature dealing with special characteristics of the IT profession. First, we describe IT professionals' occupational culture and identity and related work. Second, we discuss the implications of the constant technological change as a foundation for IT professionals. The following section of the dissertation is based on a published literature review by the author of this dissertation. It, therefore, contains similarities in structure and content (for more information, see Prommegger, Wiesche and Krcmar (2020)).

2.1.1 Occupational Culture and Identity of IT Professionals

IT professionals have assumed great importance in organizations. While they - like employees of other professions - are subject to the organizational culture in the company they work for, they also stand out due to their unique occupational culture (Guzman et al., 2008; Guzman & Stanton, 2009; Jacks et al., 2018). The concept of occupational culture connects individuals with the same profession inside and outside of their organization based on their shared educational, personal, and work experience (Trice, 2019). Based on these experiences, ideologies are solidified, which subsequently serve as the foundation for shared perceptions. This occupational culture in IT ensures cohesion between IT professionals and an easier classification of new IT professionals (Guzman & Stanton, 2009; Jacks et al., 2022).

Characteristics of IT occupational culture are described by the individuals' perception of belonging to the IT profession and by the perception of non-IT personnel (Guzman et al., 2008). Due to rapid technological change, this occupational culture is characterized, for example, by extensive technological knowledge that distinguishes members of the IT profession from other individuals. As a result, intense ethnocentrism is generated, manifesting in the feeling of superiority over other professions. IT professionals also use their jargon and share common values, such as the belief that they can help people with technology (Guzman et al., 2008). Furthermore, they value autonomy and enjoyment at the workplace (Jacks et al., 2018; Jacks et

al., 2022) and have a sense of calling to their profession (Dinger et al., 2015), making them inseparable from their profession.

A similar concept to occupational culture is the identity of IT professionals (Riemenschneider & Armstrong, 2021). The authors Riemenschneider and Armstrong (2021) describe the unique identity of IT professionals in their paper, explaining that the technological changes that occur within the profession, the facets of knowledge required, and the continuous refinement and adaptation of the knowledge base in an intellectual demanding work context are what differentiate the IT profession from other professions.

While occupational culture and identity usually lead to a strong connection within individuals of a profession, it can also lead to cultural conflicts (Guzman et al., 2008; Leidner & Kayworth, 2006). In the IT workforce literature, this topic is mainly addressed by discussing the conflicts between the technical and managerial staff (Guzman et al., 2008; Rao & Ramachandran, 2011). Rao and Ramachandran (2011) point out potential conflicts between these two occupational groups, like the centrality of IT, the need for technical and social skills, and, again, the use of jargon. Thus, IT professionals use their occupational culture to define themselves and distinguish themselves from others.

2.1.2 Technological Change as the Foundation of the IT Profession

Technological progress is happening faster than ever, causing the used technologies and, consequently, the core of every IT profession to continuously change (Chilton et al., 2010; Gallivan, 2004; Niederman et al., 2016). As a consequence, IT projects are regularly exposed to socio-technical change (Fischer & Baskerville, 2022), meaning, for example, technological transformation (Lee & Xia, 2005; Mehrizi et al., 2019; Taipalus et al., 2018) or changes in customer collaboration processes and requirements (Akbar et al., 2019). This fast technological change is an essential part of the IT profession and is reflected in the occupational culture, motivating IT professionals to continuously update their skill sets (Guzman et al., 2008; Vaast & Pinsonneault, 2021). At the same time, technological change entails the danger of fast outdated knowledge and can create a sense of perceived obsolescence (Vaast & Pinsonneault, 2021; Zhang et al., 2012).

Perceived obsolescence can have a significant impact on IT professionals. It can lead to potential negative results, like stress and anxiety (Harden et al., 2018; Tsai et al., 2007), and can even result in career or occupational culture changes (Vaast & Pinsonneault, 2021). To avoid skills deterioration, IT professionals might choose to turn away or turnover (Joseph et al., 2011; Zhang et al., 2012). A career shift in the job position, company branch, or to another firm where different sets of skills are demanded (e.g., managerial positions (Joseph et al., 2011)) would relieve the pressure of the uninterrupted need to be up-to-date.

To reduce the effect of professional obsolescence, Benamati and Lederer (2001) explored how companies can cope with rapid technological change. They identified five coping strategies: education, internal procedures, vendor support, consultant support, and endurance. Companies extensively rely on regular in-house training, which is a fruitful way to keep IT professionals in their organizations (Ferratt et al., 2012). Nevertheless, it is a personal and individual

experience: employees react to threatening obsolescence and training differently according to their attitude, motivational factors, and career stage (Pazy, 1990).

When fighting perceived obsolescence, different influence factors might affect the effectiveness of coping (Chilton et al., 2010; Gallivan, 2004; Rong & Grover, 2009). Rong and Grover (2009) developed a motivational model of technological knowledge renewal effectiveness. They demonstrate that renewal effectiveness is influenced by career orientation, perceived IT dynamism, and tolerance of ambiguity, influencing job satisfaction. Gallivan et al. (2004) examined an IT professionals' adaption to change based on "tolerance of ambiguity" and "openness to experience". They prove that those attributes differ between genders and that women are rated less regarding technological skills. Chilton et al. (2010) used the theory of person-job fit to examine the influence of workload, supervisor support, and job ambiguity on the strain level of IT professionals and prove that those constructs strongly affect software developers involved in rapid technological change. In summary, rapid technological development and the resulting changes motivate and challenge the IT profession and its members (Mehrizi et al., 2019; Vaast & Pinsonneault, 2021).

2.2 Career Concepts in the IT Sector

In order to study the specifications around the hiring and retention process of IT professionals, it is necessary to consider different career concepts in the IT context. The following sections, therefore, deal with career theories in the IT context.

2.2.1 Career Patterns in IT

The term career describes “the combination and sequence of roles played by a person during the course of a lifetime” (Super, 1980, p. 282). Traditional career models initially conformed to the paradigm of hierarchical corporate structures, in which an individual progresses linearly through the stages until no more progress is made (Sullivan & Baruch, 2009). Consequently, careers have been expected to progress linearly through career movements, primarily within one or two firms (Super, 1957).

Early career research often divided careers into life/career stages (Levinson, 1986; Turner, 1960). Much emphasis was placed on the early years of an individual's career. Researchers assumed that quick, early promotions positively affected career progression, leaving competitors behind. Accordingly, initial career models were often described as competition models, in which individuals must compete against their direct and indirect competitors (for example, see the tournament model (Rosenbaum, 1979)).

Over time, however, these traditional career models of linear advancement and limited organizational change have become outdated (Joseph et al., 2012). The importance of a single, lifelong employer diminished, encouraging the need for timelier career models. Major career models that have emerged from these changes are boundaryless and protean careers (Arthur, 1994; Briscoe et al., 2006; Tams & Arthur, 2010). Boundaryless careers are defined as careers with a high level of organizational and occupational mobility, meaning that professionals frequently change organizations and/or professions (Guan et al., 2019). Protean careers are defined as careers that are designed by the individual to primarily serve the individual's self-

fulfillment (Briscoe & Hall, 2006). Both career types typically break traditional definitions of career success, such as hierarchical promotions in organizations (Guan et al., 2019; Inkson, 2006). RQ3 of this thesis deals with the investigation of boundaryless careers in IT, which is why we focus on boundaryless careers in the following.

Boundaryless careers are the opposite of organizational "bounded" careers (Arthur, 1994). They describe a contemporary career concept, which enables career paths made up of "sequences of job opportunities that go beyond the boundaries of single employment settings" (DeFillippi & Arthur, 1994, p. 307). Instead of aspiring for a career within one organization, individuals with boundaryless careers also pursue job opportunities outside their organization or even profession. As boundaryless careers enable mobility across jobs, functions, and organizations, boundaryless employees exhibit higher mobility patterns between organizations and professions (Arthur, 1994; Briscoe & Hall, 2006).

Research on career paths in IT shows that career opportunities for IT professionals have broadened over the years (Wiesche et al., 2020). Early research on IT careers had described IT career paths as mirroring the dual-path concept. IT careers were traditionally classified as either managerial or technical-oriented (Chesebrough & Davis, 1983; Ginzberg & Baroudi, 1988). In contrast to previous research on dual career paths, studies, such as those by Igbaria et al. (1995); Reich and Kaarst-Brown (1999) show that IS careers cannot be classified solely as professional or managerial. Instead, research on IT careers in the 90s illustrated that IT professionals hold different career orientations, which will eventually grow toward different positions. More recent research on career patterns in IT supports this finding. Joseph et al. (2012) investigated IT career patterns by analyzing US socio-economic panel data. They found three main career paths in IT: the IT career path, the secondary labor market (SLM) career, and the professional labor market (PLM) career. While IT professionals following IT careers were found to move mainly between organizations, individuals with SLM and PLM career paths also moved across occupations (Joseph et al., 2012). This study is one of the first to illustrate how the IT profession might have evolved into a boundaryless occupation (Gubler, 2011; Joseph et al., 2012).

This dissertation builds on the assumption of the transformation of the IT profession into a boundaryless occupation. The following characteristics of the IT profession make it relevant to investigate boundaryless careers in IT. First, frequent organizational change is prototypical for the IT profession, which explains the unbroken interest of IS researchers in IT turnover (Zaza et al., 2023). Second, in addition to turnover, more and more IT professionals choose turnaway (Zaza et al., 2022). Turnaway from IT refers to the decision to leave the IT profession (Joia & Mangia, 2017; Reich & Kaarst-Brown, 1999). Therefore, a large part of IT workforce research focuses on developing strategies to prevent IT professionals from leaving IT (Armstrong et al., 2015; Brooks et al., 2015; Joseph et al., 2015; Zaza et al., 2022). Little research has been conducted on other forms of boundaryless careers in IT - i.e. individuals who move into the IT sector from non-IT professions (late-entry IT professionals - Joseph et al. (2012)), or individuals who decide to return after leaving (boomerang IT professionals). With this dissertation, we aim to provide a better understanding of IT professionals pursuing contemporary career concepts and how they can be best employed in companies.

2.2.2 Career Anchors and Career Success in IT

Two essential constructs for explaining career decisions are the theories of career anchors and career success. Career anchors describe an individual's self-concept about 1) individual talents and abilities, 2) attitudes and values, and 3) motives and needs related to the individual's career (Schein, 1996). They function as a stabilization force, directing the individual's decisions on career movement. Examples of career anchors are managerial or technical competence, covering the wish to build competence in management or technical knowledge; security, meaning that the person seeks organizational or geographical stability in their career; autonomy, a wish for independent working; entrepreneurial, an urge to start one's own business; pure challenge, gaining sense by challenging tasks or jobs; and lifestyle, the preference to live a fulfilling private life.

In IT workforce research, career anchors have been proven to help describe the career mobility of IT professionals (Chang et al., 2011; Chang et al., 2012; Crepeau et al., 1992). Early assumptions in research on the influence of career anchors on IT professionals' careers found technical and managerial competence as the two dominant anchors (Igbaria et al., 1995), which would support the dual career paths system in IT. However, Crepeau et al. (1992) found IT professionals to follow several career anchors in parallel, implying that the dual career paths concept of IT professionals might need to be revised. Similarly, Igbaria et al. (1995) found similar evidence of the many diverse career orientations and found, against expectations, service, geographical security, and job security as the most mentioned career anchors. With the new generation of IT professionals, a renewed shift in career anchors can be expected. Modern definitions of career success and contemporary views on the understanding of the profession are shaping the relationship of IT professionals with their profession (Arnold et al., 2017; Chang et al., 2012; Prommegger, Intane, et al., 2020; Taylor & Joshi, 2019).

Career success is the "accomplishment of desirable work-related outcomes at any point in a person's work experiences over time" (Arthur et al., 2005, p. 179). Traditionally, career success is often defined as objective factors, such as compensation or promotion (Cox & Harquail, 1991; Igbaria & Wormley, 1992; Poole et al., 1993). However, career success can strongly depend on one's values, which is why career success can take on many different facets, such as the meaningfulness of work, having enough time for family, or simply being happy (Guan et al., 2019; Spurk et al., 2019).

Modern career concepts have a lasting impact on our understanding of career success (Guan et al., 2019; Spurk et al., 2019). Whereas in the past, it was easier to compare careers and their success in more stable and long-term employment relationships, it is now more difficult to compare due to the emergence of increased diversity in careers (Gubler et al., 2014). Corporate advancement, in particular, is difficult to measure as career mobility nowadays is no longer just vertical, but also increasingly horizontal (Greco & Kraimer, 2020), which makes them harder to compare.

While the role of subjective career success factors (CSFs) is mostly overlooked, the influence of compensation and promotion in the IT context is well investigated (Ge et al., 2015; Slaughter et al., 2007; Tan & Igbaria, 1994; Thatcher et al., 2006). IT professionals are among the best-

paid jobs worldwide, giving salary a special role in the IT context. Advancement in IT, on the other side, often meant moving away from IT into higher management positions (Ginzberg & Baroudi, 1988). Companies nowadays, however, increasingly offer various career paths that allow IT professionals to choose between different types of careers (Joseph et al., 2012). A transformation in the priorities of young employees (Thatcher et al., 2012), such as a better work-life balance, is expected to shift the order of essential career anchors and CSFs. This dissertation addresses this transformation and aims, among other aspects, to identify essential influence factors for the career choices of prospective IT professionals.

2.2.3 Turnover of IT Professionals

Due to the high turnover rate in the IT sector, the investigation of IT professionals' turnover behavior has become a leading research stream in the IT workforce literature (Wiesche et al., 2020). High rates of turnover (i.e., voluntary leaving of a company) of IT professionals in companies present them with several challenges (Maier et al., 2015). First, turnover significantly contributes to sharpening the shortage of skilled IT labor in these companies and can result in difficulties driving innovations (Staw, 1980). Second, leaving employees entails leaving knowledge. Companies, therefore, need to develop strategies to ensure that the knowledge stays in the company before it leaves with the departing person (Loebbecke et al., 2016; Wang et al., 2008). Third, resignations can disrupt teamwork and lead to problems with team coordination and performance (Davis et al., 2014), and can even cause turnover contagion (Felps et al., 2009). Finally, high turnover rates lead to high re-hiring costs and potential losses for the bridging period (Cascio, 2015; Mitchell, Holtom, & Lee, 2001). Retaining IT professionals and preventing, or instead delaying, turnover decisions of their IT staff are, therefore, critical drivers for companies and their technology departments.

In order to prevent IT employees from leaving their employers, identifying the main drivers of turnover in IT is essential. Early turnover literature attributes the desire to quit to an individual's comparison between ease of movement and desire to move (March & Simon, 1958). The meta-analysis of Joseph et al. (2007) is grounded in this idea and provides an overview of turnover factors in IT. By analyzing 31 studies on IT turnover intention, the authors examine the influence of job-related factors, organizational factors, demographics, and human capital on job satisfaction (the desire to move) and perceived job alternatives (the ease of movement) of IT professionals. The results illustrate how turnover intention in IT is indirectly influenced by factors such as job performance, role conflicts, pay, promotability, gender, and education. Based on these results, Joseph et al. (2007) propose a contextual model of the turnover of IT professionals. The authors combine the unfolding model of voluntary employee turnover (presented in the next section), the job embeddedness theory, and the theory of desire and ease of movement, and extend these theories by organizational, job-related, and individual factors in IT that influence IT professionals' turnover behavior (Joseph et al., 2007).

An essential construct of the contextual model of the turnover of IT professionals is the unfolding model of voluntary employee turnover by Lee and Mitchell (1994). With this theory, the authors have revolutionized our understanding of turnover decisions. Unlike other theories, the authors suggest that employees follow one of five different decision paths when quitting, influenced by intermediate steps, such as image violation, satisfaction, and evaluating job

alternatives. While the concepts of satisfaction and evaluation of job alternatives build on previous theories, the authors are the first to introduce a trigger of turnover cases that have gone unnoticed: shocks. Shocks are critical events in the employee's work or private life that prompt thoughts of leaving (Holtom & Inderrieden, 2006). As these shocks have a highly jarring character, they can lead to impulsive decisions to leave without further consideration and are thus highly relevant to explain the turnover behavior of employees (Holtom & Inderrieden, 2006; Lee & Mitchell, 1994).

IS researchers have contextualized the unfolding model of voluntary employee turnover in the IT workforce. By testing this model in an IT context, Niederman et al. (2007) identified paths in the model that were initially not suggested by Lee and Mitchell (1994) and, therefore, proposed an extension of the model to make it applicable in the IT context. The authors especially suggest highlighting the script (plan B) and shocks (jarring events) in the IT context and extending the model accordingly.

Niederman et al. (2007) attribute the need for the extension of the unfolding model in the IT context to an imbalance in the IT job market. Due to the high demand for IT specialists, the ease of movement for IT professionals is kept at a high level. Consequently, shocks play an exceptionally important role in IT, and scripts (Plan B) can easily be triggered. Due to their excellent position in the job market, shocks can fast and fully unfold their influence, as IT professionals can move to other organizations anytime, with low effort (Niederman et al., 2007). Niederman et al. (2007) back up this theory with their study, showing that 66 % of all turnover cases in their sample (n=124 IT professionals) were triggered by shocks. While we know that shocks trigger the turnover of IT professionals, we lack an understanding of how we can buffer their effects.

2.2.4 Retention of IT Professionals

Building on turnover research, IT workforce researchers have started investigating why IT professionals decide against leaving their organizations and instead staying with them (Agarwal et al., 2006; Pflügler et al., 2018). HR practices to retain IT workers can be divided into five areas (Agarwal et al., 2006): 1) The *adaptation of the work environment* describes measures that bind the employee to the company due to the work environment (exciting work, good team, competent supervisor, or similar). 2) *Providing career development* describes measures that retain employees because of promising career opportunities (career paths in the company, promotions, regular training, or similar). 3) *Community-building initiatives* in organizations form a network that connects employees to the company - for example, through joint social activities. 4) *Monetary incentives* encourage employees to stay with the company because of money and additional benefits. 5) *Employment incentives* focus on job security and stability to keep IT professionals in the company. Pflügler et al. (2018) build on this idea and recommend classifying IT professionals according to different types and developing appropriate retention strategies. They suggest the five core strategies *1) adaption of compensation, 2) adaption of working arrangement, 3) improving career development, 4) changing of department,* and *5) introducing varying work tasks* and explain how these measures should be adjusted according to the needs of the (potentially leaving) IT professional.

One of the main theories discussed for investigating retention in the IT context is the theory of job embeddedness. Job embeddedness is defined as the network of psychological, social, and financial factors that binds individuals to their organization (Mitchell, Holtom, Lee, et al., 2001). Employees with stronger bonds feel a stronger connection to the company and are, therefore, more willing to remain in place or at least have more significant difficulties leaving it (Mitchell, Holtom, Lee, et al., 2001).

Job embeddedness has been found to have decreasing effects on turnover intention, voluntary turnover, and related concepts (Lee et al., 2004; Mitchell, Holtom, Lee, et al., 2001; Tanova & Holtom, 2008). Furthermore, it positively influences performance behavior (Halbesleben & Wheeler, 2008; Lee et al., 2004) and citizenship behavior (Lee et al., 2004). Job embeddedness is, therefore, suitable for predicting turnovers but can at the same time be distinguished from similar constructs such as job satisfaction or organizational commitment, and explains a significant amount of variance above and beyond those measures (Crossley et al., 2007; Felps et al., 2009; Mitchell, Holtom, Lee, et al., 2001).

Job embeddedness has attained attention in the IS literature in the last few years (Dinger et al., 2022; Joseph et al., 2007; Ryan & Harden, 2014). Dinger et al. (2022) introduced the concept of workgroup embeddedness and explained how IT professionals become embedded in their corporate workgroup or unit. Ryan and Harden (2014) showed how the job embeddedness of male and female IT professionals differ and illustrate how females perceive more organizational sacrifice than males and that male IT professionals, in general, have more links in the organization. Joseph et al. (2007) include job embeddedness as one dimension in their contextual model of turnover of IT professionals, highlighting the importance of job embeddedness when investigating the turnover of IT professionals. This dissertation builds on research on retaining IT professionals and examines different ways to retain IT professionals in organizations.

2.3 Recruitment in the IT Sector

Due to the high competition in the IT job market on the employer side, recruiting IT professionals is a challenge for many companies. Employers looking to hire IT professionals must prevail over other companies in the application process and position themselves well in the market. Whereas in the past, traditional incentives such as money and promotion were used to attract IT professionals, this will no longer be enough in the future. Firstly, money and promotions no longer offer unique selling propositions. Secondly, the next generation of IT professionals is shaped by contemporary values and is looking for a broader range of benefits. In the following, we present literature on different approaches to hiring IT professionals and provide insight into the characteristics of the next generation of IT professionals.

2.3.1 Hiring IT Professionals

Employee recruitment includes the attraction, training, and on-boarding of graduates, unemployed persons, or employees under contract with another company (Janz & Nichols, 2010). Due to the high number of job alternatives in the IT job market, companies with a need for IT professionals must position themselves as an attractive employer and stand out from the competition. In order to increase their attractiveness, these companies often pursue the process

of employer branding, namely "the process of building an identifiable and unique employer identity, and the employer brand as a concept of the firm that differentiates it from its competitors" (Backhaus & Tikoo, 2004, p. 502).

IS research has addressed employer branding in the IS context. Dabirian et al. (2019) describe eight sub-factors that impact the selection of employers by IT professionals. The authors highlight the roles of social value (e.g., organizational culture), interest value (e.g., exciting tasks), economic value (e.g., salary, benefits), and brand image and describe that these factors, in particular, should be taken into account by companies when recruiting IT professionals (Dabirian et al., 2019).

In a study by Thatcher et al. (2012), the authors deal with the entry-level IT job seekers' labor market. Using signaling theory and image theory, they explain the interaction of IT job seekers and IT employers in the IT labor market. They argue that it is worthwhile to segment IT entrants and address their preferences according to the type of employer they are looking for. They introduce IT consulting firms, IT vendors, and non-IT-oriented firms that require in-house IT workers as possible different categories of employers in IT. Furthermore, they distinguish three factors that influence the decision for or against an IT job: job security, prestige, and the nature of work. By combining the categories of employers and the influence factors, the authors provide suggestions on addressing the specific needs of different IT job seeker groups. For example, whereas IT consulting jobs would be chosen primarily for prestige, job seekers looking for in-house IT jobs value their job security significantly more than job seekers looking for IT consulting jobs (Thatcher et al., 2012). Thus, the authors extend past research on recruiting IT professionals that had yet to distinguish between different types of job seekers in IT.

The topic of salary is a significant subject of discussion when hiring IT professionals. Due to high demand, IT professionals are usually paid significantly better than other professions (Wang & Kaarst-Brown, 2014). However, salary does not diminish the importance of salary in IT job selections but drives it. IT professionals expect a good salary (Ge et al., 2015), usually consisting of a fixed base salary and incentives such as benefits and bonuses and being adjusted regularly to remain competitive with other employers (Agarwal & Ferratt, 2002). Additional benefits and bonuses may include signing and referral bonuses (Weitzel et al., 2009), health benefits, stock purchases, pension (401k) and retirement plans, performance awards (Sumner, 2001), and training and development opportunities (Ferratt et al., 2005).

Regarding hiring strategies for IT professionals, IT companies rely on various recruiting tactics. However, two are discussed particularly often: employee referrals and university networks. Due to the large number of employers to choose from, employee referrals play a unique role in IT (Agarwal & Ferratt, 2002; Weitzel et al., 2009). Current employees recommend their employer to future potential employers and, in some cases, also receive compensation for successful placements. This approach makes the selection process faster and more efficient.

Additionally, referrals are usually more reliable and require substantially less time for socialization and integration into the company (Agarwal & Ferratt, 2002; Weitzel et al., 2009). Employee referrals are, therefore, a cost-effective method that relies on employees as additional

recruiters but requires constant motivation on the company's part (Weitzel et al., 2009). Next to employee referral, there is great potential in attracting college graduates to IT companies. Accordingly, it is essential for IT companies to build strong networks with universities and to secure their following employees at an early stage (Agarwal & Ferratt, 2002). Early career interventions show promising prospects for recruiting young IT professionals (Deng et al., 2023). In particular, university-based work experiences, such as internships and cooperative education at an early stage, show a positive influence on the entry of university graduates into professional life and ensure early on that students will then decide in favor of this company with regard to career entry (Setor & Joseph, 2016, 2021).

2.3.2 The Next Generation of IT Professionals

In order to overcome the IT skills shortage and to drive technology innovation, many companies are counting on the next generation of IT professionals - i.e., the current IT students enrolled at universities. Therefore, IT students and young IT professionals have been the target group of many IS studies investigating the next generation of IT professionals. Central questions in this context are reasons for or against studying IT-related study programs (Deng et al., 2023; Ferratt et al., 2010; Heinze & Hu, 2009), how to retain IT students in their studies/jobs (Setor & Joseph, 2016), or how initial career stages of IT professions develop (Ge et al., 2015; Thatcher et al., 2012). In the following, we introduce literature covering these questions.

The first step in combating the shortage of IT professionals is attracting young individuals to IT training or IT studies. Therefore, it is essential to understand the reasons for and against the choice of an IT apprenticeship/study or, ultimately, the choice for or against the IT profession as a career choice. Ferratt et al. (2010); Heinze and Hu (2009) and Deng et al. (2023) therefore investigate IT students, their characteristics, and their reasons for choosing IS majors. Heinze and Hu (2009) found that students with higher intentions to pursue IT majors in college have high self-evaluation expectations. Against expectations, however, IT job availability does not affect students' choices as they seem not to be informed about the high demand for IT professionals, at least not back in 2009 (Heinze & Hu, 2009). Ferratt et al. (2010) demonstrated how the desire to link business and technology is unique for IS students and highly motivates them to choose IS as their major. Furthermore, they identified the practical application of coursework and daily variety as main but not IS-specific motivation factors. Deng et al. (2023) investigated first-generation students. They found interest in the subject, perception of job opportunities, and technical and social capital decisive factors for first-generation students to consider an IT career.

Another step to tackle the IT skills shortage is promoting the retention of IT students and young IT professionals in the IT profession. Just because IT students study IT does not mean they will stay in IT long-term. Therefore, investigating the persistence of the next generation of IT professionals is essential. Regarding career interventions for IT students during college, Setor and Joseph (2021) suggested that cooperative education, internship, and mentorship experiences increase the likelihood of students finding initial IT employment. Furthermore, they demonstrated that IT graduates who received mentoring and conducted internships showed a higher level of persistence in IT. When it comes to salary, Setor and Joseph (2016) found that young IT professionals with IT educational backgrounds receive higher salaries than those

without formal IT educational backgrounds, mainly because of less spending on training and onboarding. This is congruent with other findings of IT workforce research (Ge et al., 2015). While not all IT graduates decide to start their careers in the IT field, those usually receive significantly higher compensation than those that do not (Ge et al., 2015). Furthermore, regarding gender, most female IS graduates receive lower salaries than their male counterparts, resulting in more females leaving IT (Ge et al., 2015). Consequently, the retention of IT professionals, especially females, is still a significant challenge in the IT context, also regarding the next generation of IT professionals.

After providing an overview of the related literature for the dissertation, the next chapter provides an overview of the research methodologies used.

3 Research and Methodological Approach

Our studies were guided by the urge to create recommendations for action for companies and researchers on attracting and retaining IT professionals to address the IT skills shortage. In doing so, we used established theories from psychology and human resources (HR) research and focused on the adaption of these theories to the IT context, which makes the results specific to the IT profession. In line with the approach of testing established theories, we followed a predominantly post-positivism paradigm, reflected in our focus on a quantitative study design (Gefen, 2019). The following chapters describe how the IT context has influenced our studies and which research methods we have used.

3.1 Highlighting the IT Context

For IT workforce research to be relevant and justified as a separate discipline of IS research instead of HR research, it is essential to anchor IT workforce research as part of IS research. With our research, we join a long tradition of researchers dealing with investigating the IT workforce. Since the 1990s, IS researchers have investigated the specifics of the IT job market and the specifications of IT professionals (Wiesche et al., 2020). While no one characteristic of the IT profession is unique to the IT profession itself, it is the interplay of factors that makes the IT profession unique and, therefore, worthy of study (Prommegger, Wiesche, & Krcmar, 2020; Riemenschneider & Armstrong, 2021).

In this dissertation, we emphasize considering the IT context within the studies conducted. We highlight the context of studies - while considering it in the limitations - as an opportunity to examine the specific context of the IT profession and develop new insights into it accordingly. In our studies, we are strongly guided by the guidelines of Hong et al. (2013) that describe two main approaches to contextual theory development: single-context theory contextualization and cross-context theory replication. The first describes adapting theories by adding or removing core constructs; the second describes replicating theoretical models in different contexts. In four of our studies, we followed the approach of cross-context theory replication by applying and testing theoretical models mainly from HR and psychology in the IS context without adapting them (P1, P2, P7, P8). In the rest of our studies, we followed a single-context theory contextualization approach by adding constructs to existing, established theories to address the

specific context of IT (P3, P4, P5, P6). For a detailed comparison of the approaches, see Figure 2.

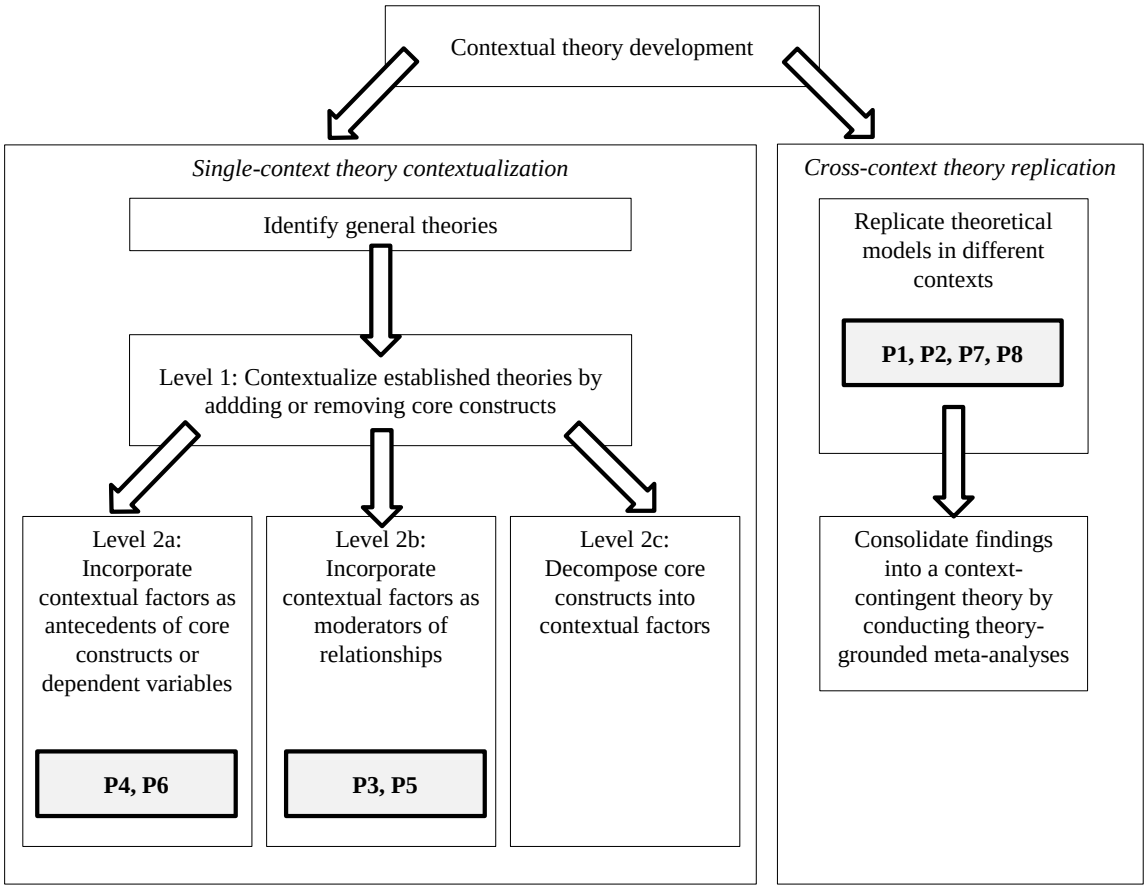

Figure 2: Contextual Theory Development in Thesis, by Hong et al. (2013)

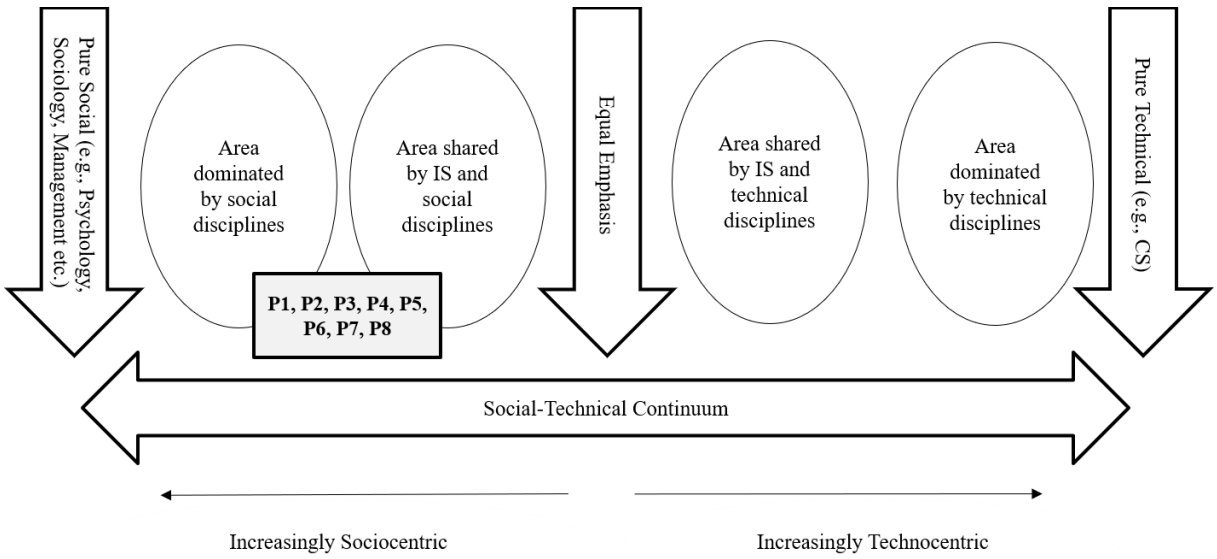

Figure 3: The Socio-Technical Continuum, by Sarker et al. (2019)

In highlighting the IT context in our studies, we find ourselves in different positions on the social-technical continuum (Sarker et al., 2019). We consider our studies to have an increasingly socio-centric orientation, as seen in Figure 3. Despite this socio-centric orientation, or precisely because of it, we have taken great care in all our studies not to lose sight of the IT artifact (Orlikowski & Iacono, 2001) and either to anchor it centrally in our thoughts and theses or to place its influence on our results in the focus of our discussions.

3.2 Research Approaches

This dissertation is characterized by a post-positivism perspective (Gefen, 2019). The research questions and methods were defined according to an objective ontology, assuming that reality exists, but can be known only imperfectly. According to this paradigm, we followed a predominantly quantitative approach, enriched in some places with a qualitative approach where appropriate (P2). Due to the nature of the research questions, we opted for a multi-method approach, meaning that we used several different quantitative analyses in the thesis (Venkatesh et al., 2013). We introduce the research methods and data sets in the following. Table 3 provides an overview of the methods used and the data set per paper.

3.2.1 Statistical Testing

ANOVA Testing: The ANOVA test is part of variance analyses and examines the relationships between a discrete independent variable (IV) and a continuous dependent variable (DV). Generally, the test can examine mean differences based on groups (Backhaus et al., 2015; Tabachnick et al., 2007). In this dissertation, ANOVA was used in P1 to calculate differences between respondents' salaries among clusters of young IT professionals and in P8 to calculate differences among clusters in the data set of boomerang IT professionals related to job mobility and outcomes variables such as life satisfaction or income.

Chi-Squared Analysis Testing: The chi-squared test of independence examines the relationship between two discrete variables. Specifically, the test is used to assess whether the observed frequencies of a combination of variables also correspond to the expected frequencies. If this is not the case, and the distribution is not as expected, two variables are related (Backhaus et al., 2015; Tabachnick et al., 2007). In the course of this dissertation, the chi-square test was used in P1 to calculate differences between career clusters and job characteristics of young IT professionals, in P2 to calculate differences in career success definitions between genders, and in P8 to analyze differences between identified clusters and job characteristics of boundaryless IT professionals.

3.2.2 Sequence Analytic Approach

We followed a sequence analytic approach to investigate the career paths of specific groups in the IT profession (young IT professionals in P1, late-entry IT professionals in P7, and boundaryless IT professionals in P8). This approach is well-established for analyzing careers (Abbott, 1990) and has already been applied in the IT context (Joseph et al., 2012). When conducting this analysis, we followed the approach described by Joseph et al. (2012).

Table 3: Research Methods in Publications

No	Authors	Title	RQ	Method	Data Set
P1	Prommegger, B. Intane, J. Wiesche, M. Krcmar, H.	What Attracts the New Generation? Career Decisions of Young IT Professionals	RQ1	**Quantitative**: 1) Sequence analytic approach (Optimal matching analysis + cluster analysis) 2) Statistical Testing (Chi-Squared + ANOVA Test)	**Longitudinal, secondary Data (**NLSY97); 243 Career paths of young IT professionals
P2	Prommegger, B. Arpaci, S. Krcmar, H.	The Things That Drive Us – How the Next Generation of IT Professionals Defines Contemporary Career Success	RQ1	**Mixed Method**: Qualitative Coding + Statistical Testing (Chi-Squared Test)	**Survey** 127 IT students
P3	Prommegger, B. Arpaci, S. Krcmar, H.	Leaks in the IT Workforce Pipeline: Investigating IT Students and Their Plans to Leave or Stay in the IT Profession	RQ1	**Quantitative**: Multivariate Regression Analysis	**Survey** 180 IT students
P4	Prommegger, B. Huck-Fries, V. Wiesche, M. Krcmar, H.	Agile and Attached: The Impact of Agile Practices on Agile Team Members' Affective Organisational Commitment	RQ2	**Quantitative**: Partial Least Squares Equation Modeling	**Survey** 172 IT professionals
P5	Prommegger, B. Wiesche, M. Thatcher, J. B. Krcmar, H.	The Training Paradox of IT Professionals-Who Leaves, Who Stays?	RQ2	**Quantitative**: Theoretical Development of Structural Equation Model	**Theoretical development** No data
P6	Prommegger, B. Thatcher, J. B. Wiesche, M. Krcmar, H.	When your data has COVID-19: how the changing context disrupts data collection and what to do about it	RQ2	**Quantitative**: Partial Least Squares Equation Modeling (PLS-SEM) + Quantitative Significance Testing (Chi-Squared test)	**Survey** 251 IT professionals
P7	Prommegger, B. Wendrich, M. Wiesche, M. Krcmar, H.	Short-term Affair or Long-term Commitment? An Investigation of Employees without IT Background in IT Jobs	RQ3	**Quantitative**: Sequence analytic approach (Optimal matching analysis + cluster analysis)	**Longitudinal, secondary Data (SOEP)** 355 career paths of late-entry IT professionals
P8	Prommegger, B. Arshad, D. Krcmar, H.	Understanding Boundaryless IT Professionals: An Investigation of Personal Characteristics, Career Mobility, and Career Success	RQ3	**Quantitative**: 1) Sequence analytic approach (Occupational coding + sequence creation) 2) Statistical Testing (Chi-Squared + ANOVA Test)	**Longitudinal, secondary Data (SOEP)** 849 career paths of IT professionals

The sequence analytic approach consists of three steps. Firstly, the career paths of the individuals are formed by stringing the different career steps together and presenting them as a sequence. In our case, we created a career path for each individual studied, in which the respective job was entered for each year. Afterward, we compared the individual career paths for their similarity using the optimal matching analysis of Abbott and Forrest (1986). This method calculates the resemblance scores of two career sequences by calculating the "costs" between the career sequences that arise from substitution, insertion, and deletion. This means that similar career paths have low costs, while different career paths have high costs. The result of this analysis is a distance matrix that shows the similarities and differences between the careers (Abbott & Forrest, 1986). As a third step, we used cluster analysis to group common career paths (Kruskal, 1983; Murtagh & Legendre, 2014). Using the distance matrix, we built clusters using hierarchical agglomerative clustering. We used a bottom-up approach, which assigns a career path to its closest cluster and merges paths to create clusters.

3.2.3 Regression Analysis

Regression analyses allow us to investigate the relationship between one or several IVs and one DV (Backhaus et al., 2015; Tabachnick et al., 2007). Mathematically spoken, the multiple regression analysis can be expressed as follows:

$$y = \beta 0 + \beta_1 X_1 + \cdots + \beta j X j + u$$

y = DV, $\beta 0$ as the intercept, βj as the coefficient of variable Xj, and u as the error term. In this dissertation, we used multivariate regression analysis in P3. In this publication, we examined whether IT students' boundaryless career attitudes (IV) affect their plans to turnaway from IT (DV) at some point in their careers. Furthermore, we examined how professional identification influences this relationship (moderation).

3.2.4 Partial Least Squares Structural Equation Model

We used structural equation modeling for two of our papers (P4 + P6). This type of analysis is a multivariate analytical approach to test and estimate complex causal relationships among variables (Backhaus et al., 2016; Weiber & Mühlhaus, 2014). Structural equation modeling belongs to the second generation of statistical techniques. It differs from the first-generation methods in that not only observable variables are included in the analysis, but also unobservable variables are measured by indicators (Hair et al., 2017). Structural Equation Models (SEM) differ from multiple regression in that SEM also allows the study of multi-level dependence relationships, which are mediators that act as both independent and dependent variables.

In general, two types of analysis methods are distinguished: covariance-based SEM (CB-SEM) and variance-based, partial least squares SEM (PLS-SEM) (Astrachan et al., 2014). These two types differ in their type of analysis, as well as in their requirements and use cases. CB-SEM uses a maximum likelihood estimation procedure. It is primarily used to test and confirm theories that have already been established. PLS-SEM uses a regression-based ordinary least squares estimation method (Hair et al., 2017). This method is primarily used for exploratory studies whose theories and models still need to be established.

For both studies (P4 + P6), we chose PLS-SEM because the studies were exploratory and/or had a small sample size and/or did not have normally distributed data. When calculating the SEM in our papers, we conducted four steps: 1) specification of the path model, 2) estimation of the path model, 3) evaluation of the measurement model, and 4) evaluation of the structural model (Hair et al., 2017). In P5, we theoretically developed and introduced a structural equation model; however, the paper does not include the actual analysis of the model. The detailed analyses can be found in the individual papers.

3.2.5 Qualitative Approach

For identifying relevant CSFs (P2), we used a qualitative approach that involved coding the IT students' definitions of career success. We chose this approach as contemporary career success definitions in IS are not well researched, and we intended to explore these phenomena in detail to derive novel contributions to theory (Venkatesh et al., 2013). For the coding steps, we used both inductive and deductive coding processes and considered methods of the grounded theory methodology (Mayring & Fenzl, 2019; Strauss & Corbin, 1990). First, we were guided by established studies on career success and oriented ourselves on their categorization of career success (Gubler, 2011; Spurk et al., 2019). Following these publications, we used an axial coding approach and divided the definitions into several subcategories. In the second step, we followed selective coding and merged the subcategories into main categories, which we then presented as the main categories of CSFs in our sample.

3.3 Data Sets

Surveys: A large part of our studies is based on survey data (P2, P3, P4, P6). All these surveys were designed appropriately for the study context and the target group. The specific characteristics of the surveys can be found in the individual publications. They differ according to the target group (P2, P3: IT students; P4, P6: IT professionals) and the study objective: perception of career success (P2); perception of the IT profession (P3); factors influencing the turnover of IT professionals (P4, P6). Table 4 provides an overview of the used data sets.

Table 4: Survey Data in Publications

Survey No	Goal	Target Group	Data collection procedure	Year of Data Collection	Response	Used in Study
1	Investigation of future career plans of the next generation of IT professionals	IT Students	Questionnaire was sent to ~ 700 IT students at 3 German universities	December 2020	n= 301 IT students (response rate = 43%)	**P2:** 127 IT students **P3:** 180 IT students
2	Investigation of work engagement of agile team members	IT professionals working in agile teams	Questionnaire was sent to 380 IT professionals working at a German company	January 2018	n= 172 IT professionals (response rate = 45.2%)	**P4:** 172 IT professionals
3	Investigation of the influence of training on the turnover intention of IT professionals	IT professionals	Questionnaire was sent to 7 firms in the German IT sector, estimated reach: 700 IT professionals	February – April 2020	n= 251 IT professionals (response rate = 35.9%)	**P6:** 251 IT professionals

Secondary Data: For investigating a larger target group, as well as for studying changes over time, researchers are frequently making use of secondary data, such as panel data, provided by countries or companies. These kinds of panel data contain both time series and cross-sectional dimensions. They are characterized by the fact that the same economic units (individuals, firms, countries) are observed over several periods. We used two socio-economic panel data in the course of the dissertation: 1) The National Longitudinal Survey of Youth 1997 (NLSY97) from the US Bureau of Labor Statistics (BLS) (P1), and 2) the German "Sozio-oekonomische Panel" (SOEP) (P7, P8). In the following, we introduce the two data sets separately. Table 5 provides an overview of the used secondary data.

1) NLSY97

The NLSY97 is a longitudinal program of the US. Bureau of Labor Statistics (2021) in which 8984 US citizens born between 1980 and 1984 are followed throughout their lives. For this purpose, the respondents are regularly surveyed about different facets of their private and professional lives. The survey started in 1997 and was conducted annually until 2011. Since then, the survey has been conducted biannually. The NLSY97 is publicly available. Variables found in this dataset are Education and Training, Employment and Income, Households and Demographics, Relationships, Family, Health, Attitudes, and Crime. For our study, we used data from the categories Employment and Income, Education and Training, and Demographics. At the time of the data collection for the study in P1, 17 survey rounds were available.

2) SOEP

For P7 and P8, we used a longitudinal panel data set of the population in Germany, the so-called SOEP (Goebel et al., 2019). The SOEP is a representative survey of the German population that has been conducted annually since 1984. The survey is conducted with about 15,000 households and about 30,000 individuals (Deutsches Institut für Wirtschaftsforschung, 2023). The questionnaire includes questions on the categories of work and employment, income, health, and satisfaction. The large-scale study aims to investigate the German population's well-being and long-term social changes. When the two studies (P7, P8) were conducted, 35 survey rounds were available.

Table 5: Secondary Data in Publications

Data Set No	Goal	Target Group	Data Source	Years under investigation	Used in Study
1	Investigation of career paths of young IT professionals	Young IT professionals	NLSY97	1997 - 2017	**P1:** 243 Career paths of young IT professionals
2	Investigation of career paths of boundaryless IT professionals	IT professionals	SOEP	1984 - 2018	**P7:** 355 career paths of late-entry IT professionals **P8:** 849 career paths of IT professionals

Part B

Published Articles

4 P1: What Attracts the New Generation? Career Decisions of Young IT Professionals

Table 6: Fact Sheet P1: What Attracts the New Generation? Career Decisions of Young IT Professionals

Authors	**Prommegger**, Barbara[1] **Intane,** Jessica[1] **Wiesche**, Manuel[2] **Krcmar,** Helmut[1]
Author Affiliations	**1** - Technical University of Munich, Munich, Germany **2** - TU Dortmund University, Dortmund, Germany
Outlet	**ECIS 2020** 28th European Conference on Information Systems, 2020, Virtual
Status	**Published**

Abstract. The shortage of IT specialists calls for the entry of more young workers into the IT profession. However, little is known about young IT professionals in their early career stages. Our study, therefore, aims for a better understanding of career decisions of young IT professionals by looking at (1) patterns in contemporary IT careers, (2) the influence of career anchors in early IT career stages, and (3) the compensation of young IT professionals. We studied the career decisions of 243 IT professionals in the US, born between 1980 and 1985. The results illustrate the boundaryless IT profession and show that persistence in IT careers is related to the choice of the first job. Furthermore, whereas there was no evidence for the attractiveness of high-tech industries and small companies, IT graduates filled significantly more jobs that help evolve technological competence and were more willing to move for their first jobs. Finally, while individuals who started in IT did not have higher salaries compared to those starting in other sectors, persistence in IT was financially rewarded in the long-term. Our study provides an improved understanding of the career decisions of young IT professionals and thus helps to acquire and retain talent.

5 P2: The Things That Drive Us – How the Next Generation of IT Professionals Defines Contemporary Career Success

Table 7: Fact Sheet P2: The Things That Drive Us – How the Next Generation of IT Professionals Defines Contemporary Career Success

Authors	**Prommegger**, Barbara[1] **Arpaci**, Selin[1] **Krcmar**, Helmut[1]
Author Affiliations	**1 -** Technical University of Munich, Munich, Germany
Outlet	**WI 2022** 17th International Conference on Wirtschaftsinformatik, 2022, Virtual
Status	**Published**

Abstract. Modern career concepts revolutionize our understanding of a successful career. Employees nowadays define career success in many diverse ways, based on a variety of personal goals. To attract the next generation of IT professionals and to improve gender balance in IT, organizations must understand future IT professionals' perceptions of a successful career. By analyzing 127 personal career success definitions from IT students in Germany, we present a broad spectrum of desired CSFs in IT. We illustrate the concept of career success dualism, which describes career success as a balance between multiple factors, such as remuneration and work-life balance. Furthermore, we present how female IT students have a stronger drive toward subjective career success factors than males. Our study contributes to a better understanding of current IT students and suggests how organizations can hire and retain the next generation of IT professionals.

6 P3: Leaks in the IT Workforce Pipeline: Investigating IT Students and Their Plans to Leave or Stay in the IT Profession

Table 8: Fact Sheet P3: Leaks in the IT Workforce Pipeline: Investigating IT Students and Their Plans to Leave or Stay in the IT Profession

Authors	**Prommegger**, Barbara[1] **Arpaci**, Selin[1] **Krcmar**, Helmut[1]
Author Affiliations	**1** - Technical University of Munich, Munich, Germany
Outlet	**ECIS 2022** 30th European Conference on Information Systems, 2022, Timișoara, Romania
Status	**Published**

Abstract. To remain competitive in the fast-paced information technology (IT) industry, companies will have to rely heavily on the next generation of IT professionals. Yet we know little about future IT professionals' career plans: Are contemporary career attitudes tempting IT students to leave the IT profession? And can early professional identification prevent potential exit plans? Based on a survey with 180 IT students, we investigate how their turnaway intention from IT is shaped by their boundaryless career attitudes (BCAs), namely the desire for interdisciplinary work and the desire for inter-organizational mobility, and how professional identification influences this relationship. We find divergent effects of the two BCA forms on turnaway intention. In addition, we find a reducing effect of professional identification on turnaway intention, but also surprising interaction effects with BCAs. Our findings indicate that IT students with different BCAs follow distinct career paths across organizations and professions. Our study contributes to research on IT careers and provides guidance for organizations on how to employ future, boundaryless IT professionals.

7 P4: Agile and Attached: The Impact of Agile Practices on Agile Team Members' Affective Organisational Commitment

Table 9: Fact Sheet P4: Agile and Attached: The Impact of Agile Practices on Agile Team Members' Affective Organisational Commitment

Authors	**Prommegger**, Barbara[1] **Huck-Fries**, Huck[1] **Wiesche**, Manuel[1] **Krcmar,** Helmut[1]
Author Affiliations	**1** - Technical University of Munich, Munich, Germany
Outlet	**WI 2019** 14th International Conference on Wirtschaftsinformatik, 2019, Siegen, Germany
Status	**Published**

Abstract. The current shortage of information systems (IS) specialists is leading to a strongly competitive labour market for the IT workforce. Technology companies need opportunities to prevent high replacement costs and knowledge loss by strengthening the affective organisational commitment (affective OC) of their employees. Using structural equation modelling, we investigate the influence of agile information systems development (ISD) on team members' affective OC. Our results demonstrate that agile project management (APM) positively predicts affective OC directly as well as indirectly via team members' job autonomy (JA) and their supervisors' support (SS). Our study gives empirical evidence on the relationship between agile ISD practices and affective OC and provides implications how to successfully leverage team members' affective OC. For practitioners, our research expounds why and how agile ISD is a suitable instrument to transform leadership culture within the company so as to raise affective OC beyond the IT workforce.

8 P5: The Training Paradox of IT Professionals - Who Leaves, Who Stays?

Table 10: Fact Sheet P5: The Training Paradox of IT Professionals - Who Leaves, Who Stays?

Authors	**Prommegger**, Barbara[1] **Wiesche**, Manuel[2] **Thatcher**, Jason Bennett[3] **Krcmar,** Helmut[1]
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Outlet	**ICIS 2020** 41st International Conference on Information Systems, Virtual
Status	**Published**

Abstract. Rapid technological change requires companies to invest heavily in the training of their IT staff, which has different effects on career mobility. Whereas training can bind employees to their organization and thus lowers risk for turnover, it can also increase employees' market value resulting in higher turnover. With this paper, we propose a theoretical model to examine the training paradox of IT professionals. We argue that the effects of training on turnover depend on the type of knowledge acquired and on the employees' commitment. We propose that training, which fosters non-portable knowledge, reduces turnover, and training, which fosters portable knowledge, increases turnover. Furthermore, we argue that organizational commitment mitigates the negative effects of portable training on turnover, while professional commitment magnifies them. By applying commitment theory in the training context, we provide a better understanding of the interactions of commitment, as well as of the training paradox of IT professionals.

9 P6: When your data has COVID-19: how the changing context disrupts data collection and what to do about it

Table 11: Fact Sheet P6: When your data has COVID-19: how the changing context disrupts data collection and what to do about it

Authors	**Prommegger**, Barbara[1] **Thatcher**, Jason Bennett[2] **Wiesche**, Manuel[3] **Krcmar,** Helmut[1]
Author Affiliations	**1** - Technical University of Munich, Garching, Germany **2** - Temple University, Philadelphia, USA **3** - TU Dortmund University, Dortmund, Germany
Outlet	**EJIS** European Journal of Information Systems
Status	**Published**

Abstract. Global crises, such as the COVID-19 pandemic, change the context for research and bring with them many professional challenges for IS researchers – not the least of which is disrupting carefully thought-out data collection efforts. In this confessional tale, we describe how moving from an "open research ecosystem" to a "socially distanced research ecosystem" has affected a long-planned data collection effort. While government orders to socially distance and physically isolate may have made the world "stand still" for some, we found that these orders had dynamic and consequential effects for our in-process research. Against the backdrop of significant threats posed by the contextual change to our data collection, we explain how the crisis also opened up opportunities to invigorate our understanding of how the environment affects how we conduct research. We conclude our tale with guidelines for how to successfully respond when your research is interrupted by a change of context.

10 P7: Short-term Affair or Long-term Commitment? An Investigation of Employees without IT Background in IT Jobs

Table 12: Fact Sheet P7: Short-term Affair or Long-term Commitment? An Investigation of Employees without IT Background in IT Jobs

Authors	**Prommegger**, Barbara[1] **Wendrich,** Mathias[1] **Wiesche**, Manuel[2] **Krcmar**, Helmut[1]
Author Affiliations	**1** - Technical University of Munich, Munich, Germany **2** - TU Dortmund University, Dortmund, Germany
Outlet	**CPR 2020** ACM SIGMIS Conference on Computers and People Research, 2020, Virtual
Status	**Published**

Abstract. The IT profession is constantly changing. The rapid development of technology and the high demand for IT specialists has led to a broader and more diverse profile of IT professionals with fewer boundaries regarding organizations and occupations. As a result, companies have encouraged the migration of employees with different backgrounds into the IT sector. Drawing on the theory of the boundaryless profession, we explore this transformation in IT careers. By studying 355 career sequences of IT professionals in Germany, we investigate the career mobility of employees without an IT background working in IT jobs. Our results show that only around one-third of employees without an IT background remained in IT for the long-term. The majority of the sample, however, either returned to their original sector or moved to another after a few years in IT. Our study contributes to a better understanding of the boundaryless IT profession and sheds light on the role of employees without an IT background in IT jobs.

11 P8: Understanding Boundaryless IT Professionals: An Investigation of Personal Characteristics, Career Mobility, and Career Success

Table 13: Fact Sheet P8: Understanding Boundaryless IT Professionals: An Investigation of Personal Characteristics, Career Mobility, and Career Success

Authors	**Prommegger**, Barbara[1] **Arshad**, Daniyal[1] **Krcmar,** Helmut[1]
Author Affiliations	**1** - Technical University of Munich, Munich, Germany
Outlet	**CPR 2021** ACM SIGMIS Conference on Computers and People Research, 2021, Virtual
Status	**Published**

Abstract. Shifts in the evaluation of career success and an increase in boundary-spanning activities in the IT profession pave the way for new career models in IT. Instead of opting for a technical or managerial career in IT, more and more IT professionals follow boundaryless career forms, i.e. IT careers that do not correspond to a horizontal career path but allow career transitions between organizations and sectors. To better understand this trend, we examine three boundaryless IT professional groups-late-entry IT professionals, boomerang IT professionals, and IT leavers. Investigating German socio-economic panel data, we examine their personal characteristics, career mobility patterns, and career success factors. We find a high proportion of IT professionals following boundaryless careers, demonstrating that IT is becoming increasingly open to transition from and to other sectors. We also discuss the high proportion of women in boundaryless IT careers, thus illustrating alternative career paths for women in IT. Finally, we show that boundaryless IT professionals tend to have a higher workload in IT jobs than in non-IT jobs, yet, simultaneously, earn more and exhibit higher life satisfaction. Our study contributes to a better understanding of boundaryless IT careers.

Part C

Discussion

12 Summary of Results

In the following we present the results of this dissertation. Table 14 provides an overview of the key results. In the following we illustrate the results based on the research questions 1 - 3.

Table 14: Summary of Results

No.	Key Results
P1	• Early career paths of IT professionals can be divided into three career path clusters: 1) IT-focused careers, 2) non-IT-focused careers, and 3) managerial focused careers. • IT majors place more value on technical competence and less value on stability than non-IT majors. • While first IT jobs do not bring higher salaries, persistence in IT is financially rewarded in the long-term.
P2	• Contemporary career success is often defined as a balance between multiple, often competing factors, such as a high salary and work-life balance. • Remuneration and career advancement act as hygiene factors. • Women in IT place higher value on subjective CSFs than men in IT.
P3	• IT students with a desire to work interdisciplinarily have increased turnaway intention from IT. • IT students with a desire to work inter-organizationally have decreased turnaway intention from IT. • Professional identification, when paired with inter-organizational mobility preference, increases turnaway intention.

P4	• Adoption of agile practices increases the organizational commitment of IT professionals:
	  ○ Directly
	  ○ Indirectly by increasing job autonomy and supervisor support

P5	• Training that promotes non-portable knowledge decreases turnover. • Training that promotes portable knowledge increases turnover. • Organizational commitment decreases the impact of portable training on turnover. • Professional commitment increases the impact of portable training on turnover.
P6	• The shock of the COVID-19 pandemic influenced the turnover intention of IT professionals. • The contextual change of the COVID-19 pandemic influenced affective commitment, person-organization fit, and professional commitment of IT professionals. • Companies can contribute to an increased commitment and person-organization fit by implementing effective crisis management.
P7	• Only 33% of the late-entry IT professionals under investigation stayed in the IT sector in the long term. • Technical and professional labor workers are the most promising candidates for a successful and sustainable career transition into IT.
P8	• Boundaryless careers in IT can be divided into three career path clusters: 1) Late-entry IT professionals, 2) Boomerang IT professionals, and 3) IT leavers. • The proportion of women in boundaryless IT careers is significantly higher than in ordinary IT careers. • Boundaryless IT professionals are more satisfied and earn more in IT jobs while having a higher workload.

Summary of Results

***RQ1**: How can companies attract young IT professionals who pursue contemporary career concepts?*

Understanding early career paths of young IT professionals. With P1, we aimed to observe the IT careers of young IT professionals and draw conclusions about their career decisions in their early career phases. Therefore, in P1, we studied 243 careers of young IT professionals in the US born between 1980 and 1985. We examined their early career decisions and first job characteristics to generate a better understanding of the career paths of young IT professionals.

- ***Career paths:*** We identified three career path clusters with different focuses: 1) IT-focused careers, 2) non-IT-focused careers, and 3) managerial focused careers. When investigating these clusters more closely, we found significant differences in terms of gender, major choice in college, and salary. The sample revealed a significantly higher proportion of men and IT majors in IT-focused careers who eventually get considerably higher salaries.
- ***First job characteristics:*** We divided the sample into graduates who started their careers with IT jobs and people who started in non-IT jobs. We found that individuals who chose IT jobs as their first jobs are more likely to have higher degrees and have longer persistence in IT careers than individuals who decided on non-IT jobs as their first jobs.
- ***Career anchors:*** We divided the sample into individuals pursuing an IT major against a non-IT major. We found that IT majors place a high value on *technical competence* and are, therefore, more likely to start in IT jobs. Furthermore, they place less value on *stability* and, as a result, are more willing to move to another city for their jobs. We found no differences between the career anchors *challenge* (technical intensity of industry) and *independence* (size of the company) in terms of first job selection. The results, therefore, suggest that IT majors are no different from non-IT majors in terms of the choice of technical intensity and size of the company.
- ***Salary:*** We found that while individuals with their first jobs in IT initially did not have higher salaries than those in non-IT jobs, persistence in IT was financially rewarded in the long-term. The salary of individuals who stayed in IT careers was higher than those who made a career transition.

Perceived career success of the next generation of IT professionals. With P2, we investigated how the next generation of IT professionals defines contemporary career success. By examining 127 career success definitions by German IT students, we found ten different CSFs, which we divided into objective and subjective CSFs.

- ***Subjective vs. objective CSFs:*** We found that a large proportion of the CSFs mentioned was subjective and not objective (66.8% vs. 33.2%). Mentioned subjective CSFs were, among others, compatibility with private life, satisfaction, or meaningful work. However, since these were discussed particularly often together with objective CSFs (remuneration, advancement), we declare objective CSFs as hygiene factors that can cause particularly great harm if they are not fulfilled. This finding concludes that young IT professionals seek to be rewarded for the complex challenge of an IT education and IT career with a much-promised high salary and rapid career advancement.

- ***Career success dualism:*** We found the phenomenon of career success dualism, which describes career success definitions that not only include one CSF but instead several, often contradictory CSFs. A typical example would be career success defined as a balance of a good salary and enough time for the family. As mentioned above, IT professionals seem to be aware of the laboriousness of IT work and, therefore, demand a wide range of rewards for their work. This finding suggests that the perceived career success of the next generation of IT professionals involves a trade-off between different factors, implying that companies will need to offer a broad range of career development opportunities to meet the needs of their future employees.
- ***Gender differences related to perceived career success:*** Finally, we found that women's career success definitions differed significantly from men's in our sample. Women in IT mentioned subjective CSFs significantly more often than men in IT. Women placed less emphasis on remuneration and advancement and, at the same time, mentioned compatibility with private life and satisfaction more often than men.

Future boundaryless IT professionals and plans to leave or stay in the IT profession. In P3, we sought to determine to what extent two different forms of boundaryless career attitudes (the desire for interdisciplinary and inter-organizational experience) are prevalent in the next generation of IT professionals and how these forms affect career plans. Based on a sample of 180 next-generation IT professionals, we investigated the effects of a boundaryless mindset and how professional identification influences these effects. We present our results based on four examples of boundaryless IT students and give recommendations on how companies can best employ them in the future.

- ***Influences of boundaryless career attitudes:*** We found that individuals with a desire to work interdisciplinarily have increased intentions to leave the IT profession at some point in their careers. We also found that individuals with a desire to work inter-organizationally have a significantly lower turnaway intention from IT (leaving IT) and plan to fulfill their desire for inter-organizational moves within the safe havens of the IT sector.
- ***Interaction effects of boundaryless career attitudes and professional identification:*** We found a reducing effect of professional identification on turnaway intention, but also surprising interaction effects with boundaryless career attitudes. Contrary to our expectations, professional identification does not reduce the wish for turnaway intention if the desire is triggered by the preference for interdisciplinary work. This finding implies that young IT professionals with a wish to work interdisciplinarily have a high risk of leaving the IT profession, even with a high professional identification. Furthermore, we found that high professional identification reverses the reducing effect of preference for inter-organizational mobility on turnaway intention, indicating that a higher professional identification, when paired with inter-organizational mobility preference, increases turnaway intention.

***RQ2**: How can companies prevent the turnover of highly qualified IT professionals in a dynamic work environment?*

Work practices that influence IT turnover. In P4, we investigated the influence of agile practices on the organizational commitment of IT professionals based on a survey with 172 responses from IT professionals working in agile settings.

- ***Direct effects of agile practices on organizational commitment:*** We found that the extent of using agile project management practices (burndown chart, daily stand-up, iterative delivery, and retrospective) directly and positively influence affective organizational commitment. Based on commitment theory, we suggest that this direct impact is due to the use of agile practices and their influence on IT employees' perception of the organization. We suggest that the advocacy of agile values in the company increases the value congruence between employees and the organization. Consequently, agile practices foster the individual's identification with the enterprise.
- ***Indirect effects of agile practices on organizational commitment:*** We find that agile practices positively impact job autonomy and supervisor support, which in turn positively influences affective organizational commitment. We attribute these positive effects to the vital principle of self-organization and reduced hierarchies in IT teams. As a result, agile teams increasingly experience modern management styles that foster the collaborative self-management of groups and, at the same time, improve the perception of the supervisor and their support. Consequently, we conclude that adopting agile practices increases IT professionals' organizational commitment, thus reducing the risk of IT turnover.

Dual effects of training on IT turnover. In P5, we investigated the impact of training on the occupational mobility of IT professionals. Due to rapid technological change, training is an essential component in IT companies. However, the effect of training on the turnover decisions of IT professionals is still being determined, as, on the one hand, training increases the fit between person and employer. On the other hand, it increases the market value of the IT professional, making it easier to leave the current employer.

- ***A theoretical model of the dual effects of training on the career mobility behavior of IT professionals:*** We present a theoretical model of the dual effects of training grounded in commitment and paradox theory. First, we argue that the impact of training on turnover depends on two factors: the type of knowledge acquired in training and the level of commitment of employees. We propose that training that promotes non-portable knowledge reduces turnover, while training that promotes portable knowledge increases turnover. In addition, we hypothesize a mitigating effect of organizational commitment on the impact of portable training on turnover, and an increasing effect of professional commitment. With this model, we contribute to a better understanding of the effects of training and provide recommendations for companies on how to use training for employee development effectively.

The COVID-19 pandemic as a shock in the IT job market. Our study in P6 shows how the career plans of IT professionals can change due to external shocks.

- ***Changes in occupational mobility intentions and perceptions of organization and occupation triggered by the shock of the COVID-19 pandemic:*** By comparing the responses of survey participants before and during COVID-19, we found significant differences in the intention to quit, as well as in the mechanisms of action that can influence the intention to quit. We found that with the contextual change through the shock of the COVID-19 pandemic, the turnover intention of IT professionals decreased significantly. In addition to reduced turnover intention, we saw significant differences in perceptions of the company and the profession. In the second wave (during COVID-19), we found an increased affective commitment, a higher person-organization fit, and an increased professional commitment of IT professionals.
- ***Crisis management of IT organizations to reduce turnover intention:*** While in P6, we mainly discuss the consequences for research and provide guidance on how to deal with such contextual changes in research, these results also offer rich implications for organizations and research on IT careers and turnover. They illustrate how short-term contextual change can significantly influence turnover decisions and employee perceptions. First, with the results, we demonstrate how the shock of the COVID-19 pandemic caused many IT professionals to put their career decisions on hold. This may have been exacerbated by organizations pausing their planned hires due to high economic uncertainty in the job market. The results also illustrate that IT employees reacted significantly to companies' responses to the pandemic. We suggest that the increase in affective commitment and person-organization fit is due to companies' generous reactions due to the shock of COVID-19. Furthermore, we also saw a substantial rise in professional commitment, which we explain as IT professionals benefiting from the comparatively easy switch to working from home in IT and the IT profession's job security, even in times of crises. Lastly, we found a constant level of perceived job alternatives in IT, meaning that even in times of crisis, IT professionals were convinced that they would find an alternative job if needed. The results illustrate how external shocks can interrupt the IT job market and the career decisions of IT professionals. Furthermore, the study provides recommendations for companies for positive crisis responses and how they can contribute to an increased commitment and person-organization fit, thereby significantly reducing the risk of employees leaving their jobs in times of crisis.

RQ3: *Which alternative ways to fill vacant IT positions are most beneficial for companies and employees?*

Integrating late-entry IT professionals in the IT profession. In P7, we examined a dataset of 1100 professionals working in IT. We found that 355 individuals had at least three years of work experience in a different profession before moving to an IT job. We named them late-entry IT professionals and investigated their careers in more detail.

- ***Patterns in careers of late-entry IT professionals:*** We found two different major groups in the sample of late-entry IT professionals: long-term stayers (33%) and short-term visitors (47.8%) (plus others: 19.2%). The groups differ according to their career focus, either IT or non-IT in the long term. Long-term stayers are characterized by the

fact that they essentially stay in IT for the long-term (with short episodes outside IT). We divided this group into two distinct subgroups: IT careers (79.5%) - individuals who work in technical areas, and IT management careers (20.5%) - individuals who work in the IT management area. The second major group, short-term visitors, successfully transitions to IT in the short-term. Still, after a few years, they either return to their original profession or switch to another occupation. In this group, we found different subclusters, pointing to a different career focus: Technical labor careers (14.7%), Professional labor careers (37.6%), Craft careers (22.4%), and Clerical careers (25.3%).

- ***Successful and long-term transition to IT:*** A significant finding of P7 is that only 33% of the late-entry IT professionals under investigation belonged to the cluster of long-term stayers and, thus, remained loyal to the IT sector in the long term. In this cluster, we identified technical and professional labor workers as the most promising candidates for a successful and sustainable career transition into IT. These two groups accounted for 71% of long-term stayers in IT careers. Companies should, therefore, carefully evaluate the professional background and personal motivation of late-entry IT professionals before hiring them. After hiring, organizations will need to provide intensive onboarding for late-entry IT professionals to avoid losing them in the strenuous phase of the career transition.

Integrating boundaryless IT professionals in the IT profession. With the broadening of the IT profession and the associated flexibility to move in and out of it, the relevance of boundaryless IT professionals becomes increasingly important (Joseph et al., 2012; MacCrory et al., 2016). In contrast to P7, where we limited our study to late-entry IT professionals, in P8, we broadened our view and examined the corresponding super-category: boundaryless IT professionals, namely IT professionals with occupational changes involving the IT sector (moving out of IT/moving into IT). In a data sample of 1595 individuals, we found 594 careers that we would ascribe to the boundaryless character, as they included at least one occupational change.

- ***Patterns in careers of boundaryless IT professionals:*** We divided the group of boundaryless IT professionals into late-entry IT professionals (entering IT after work experience in a different profession), boomerang IT professionals (returning to IT after having left IT), and IT leavers (switching out of IT). The analyses show that late-entry IT professionals spend the least time in IT, based on their extensive professional experience outside of IT. This group of late-entry IT professionals mainly switched from Technician (22.2%), Non-IT Professional (19.6%), and Craft (17.3%) jobs. The boomerang IT professionals have the highest participation in managerial IT positions (5.8%) (vs. technical IT positions) amongst all groups. This is probably due to their switch back to IT for higher management positions. IT leavers worked in IT for at least three years before leaving IT and never returning. People in this group are characterized by spending most of their time in technical IT jobs (31.7%) before moving to similar occupations such as Technicians (16.3%) or Non-IT Professionals (13.7%).
- *Personal characteristics and career success of boundaryless IT professionals:* Regarding personal characteristics, the proportion of women in boundaryless IT careers was significantly higher than in ordinary IT careers. Furthermore, boundaryless IT

professionals were significantly less likely to be married than IT professionals who spent their careers exclusively in IT, which might hint at another facet of the boundaryless mindset. Regarding CSFs, we found that all groups (except IT leavers) were more satisfied in IT jobs than in non-IT jobs, even though the hours worked tended to be higher in IT jobs. Not surprisingly, there was a significant difference in salary between IT and non-IT jobs. All groups earned significantly more in their IT jobs. The difference was particularly large for late-entry IT professionals, who recorded an increase of around 718 € per month on average. In summary, this study shows that boundaryless IT professionals seem more satisfied and earn more in IT jobs while having a higher workload.

In the following, we discuss the results of this dissertation.

13 Discussion

This dissertation was motivated by the ongoing IT skills shortage, which will continue to exacerbate as digitalization progresses. We consider three starting points for organizations to address this IT skills shortage: attracting young IT professionals, retaining key IT professionals, and integrating boundaryless IT professionals. Additionally, this dissertation features a variety of theoretical links. It expands our theoretical understanding of HRM in the IT field by extending the theories of boundaryless careers, career anchors, career success, career development, shocks, and contextual change in an IT context.

Figure 4 shows an overview of the elaborated results based on two lifecycles: the professional lifecycle and the organizational lifecycle. The *professional lifecycle* deals with the perspective of the individual IT professional's career and is divided into *pre-occupational, occupational, and post-occupational* phases. Within the pre-occupational phase, we have investigated the challenge of attracting young professionals to the IT sector/profession. Within the occupational phase, we have addressed how boundaryless IT professionals can be successfully integrated into the IT sector. The post-occupational phase has not been covered in the scope of this dissertation and is only mentioned for the sake of completeness.

The organizational lifecycle covers the organization's view of the IT professional's lifespan within the company. This view deals with one job at a time and is divided into the phases *Attract, Motivate/Advance, and Retain/Turnover*. Within these three phases, we have investigated how an organization can attract young IT professionals and retain key IT professionals in the long term.

An essential component of this dissertation was the exploration of the role of context in the IT profession. While the author of this dissertation has highlighted the IT context in each paper, the unique role of context has found its way into this dissertation through the example of the contextual change caused by the COVID-19 crisis. This powerful, sudden, lasting influence affects all three levels and is shown on the right-hand side of Figure 4. In the following, we discuss our findings based on Figure 4.

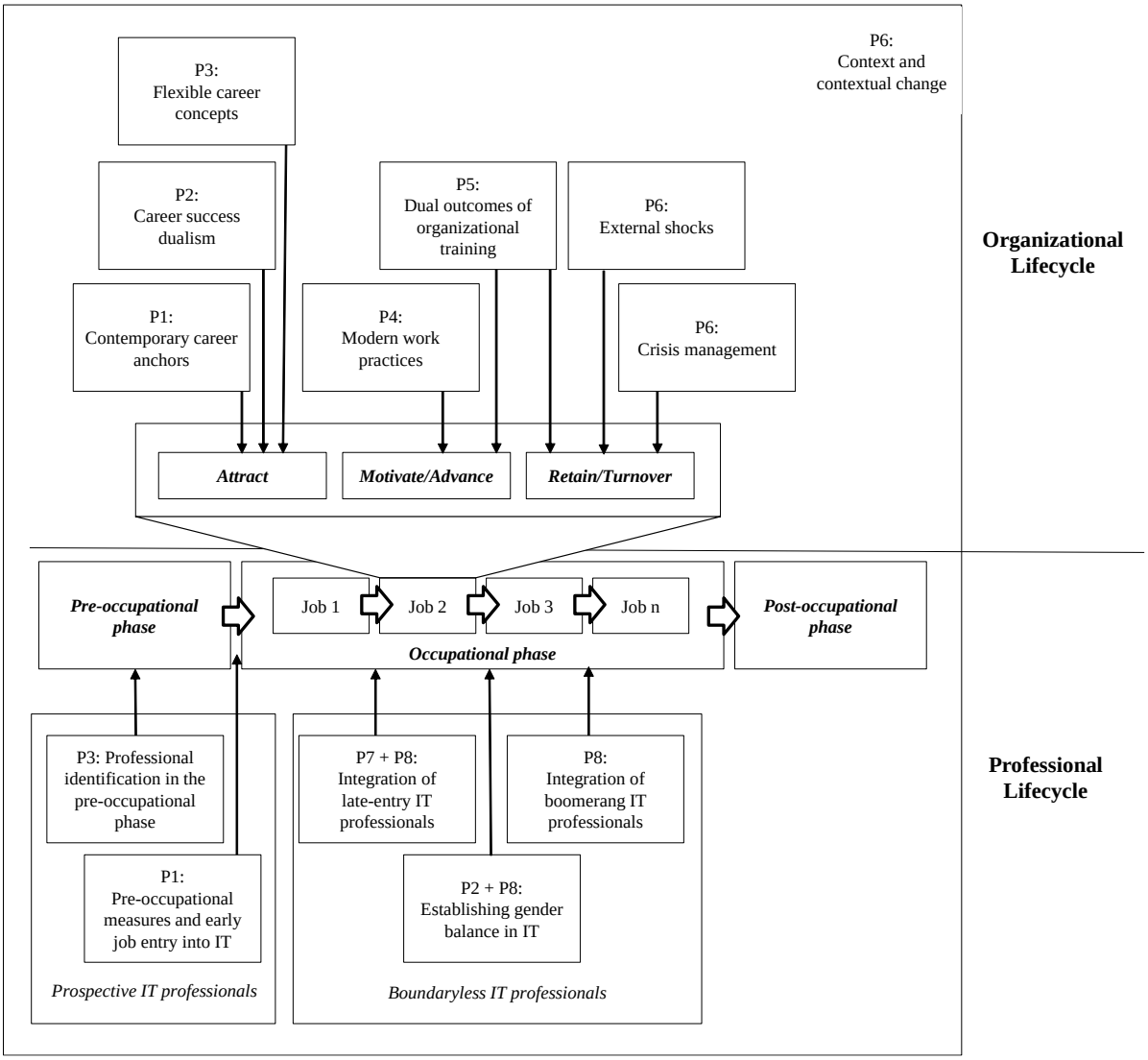

Figure 4: Condensed Illustration of Results (Own Illustration)

13.1 Professional Lifecycle

Based on Super (1975), a career consists of pre-occupational, occupational, and post-occupational phases. Naturally, there can be periods outside these phases, such as sabbaticals, parenthood, or episodes of illness. These additional phases should be mentioned here for the sake of completeness but are not part of the investigation of this dissertation and, therefore, remain undiscussed.

In the context of this dissertation, the professional lifecycle provides information on how professionals can be successfully integrated into IT and remain there in the long term. It, therefore, creates links to literature on IT careers, persistence in IT, and prevention of turnaway from the IT sector.

13.1.1 Pre-occupational Phase and Entry into IT

Prospective IT professionals. . Even before the actual appearance on the full-time job market, several measures and steps can be taken to successfully integrate young, prospective IT professionals into the IT sector and to lay the foundation for a long-term career in IT. Early

measures during education, such as internships or increasing technical and social capital, help more young IT professionals find their way into IT and subsequently remain in IT for a more extended period (Deng et al., 2023; Setor & Joseph, 2016, 2021). We extend these recommendations by identifying professional identification as a significant influence factor on the career plans of IT students. IT students with a high degree of professional identification have a decreased intention for turnaway - which means that IT students with high professional identification are less likely to drop out of the IT sector later in their careers. With this finding, we suggest that universities and companies should strengthen IT students' professional identification by increasing IT work's attractiveness to develop a robust, long-lasting next generation of IT professionals.

Additionally, we show that the early entry of IT students into the IT profession leads to a long persistence in IT. This means that persistence in IT is already noticeable at the beginning of the career. For this reason, it is all the more important to ensure that young IT professionals are well-anchored in the IT sector right from the start of their entry into the job market.

13.1.2 Occupational Phase

One of the main parts of this dissertation is investigating boundaryless IT professionals and how they might influence the IT job market in the future. We have investigated two groups of boundaryless IT professionals: late-entry IT professionals and boomerang IT professionals. Furthermore, we have investigated women following boundaryless careers.

Our findings of late-entry and boomerang IT professionals connect to the preliminary work on boundaryless careers in IT (Gubler, 2011; Joseph et al., 2012). The studies point out the importance of boundaryless IT professionals in IT and show that this occupational group will have a significant impact on IT in the future. In addition, the current changes in the generations in the IT labor market are expected to increase the number of people with a boundaryless mindset (Lyons & Kuron, 2014). Due to these changes, the IT job market, which used to be characterized by solid switching costs for individuals from other disciplines (Chesebrough & Davis, 1983; Ginzberg & Baroudi, 1988), will be more open, resulting in more job as well as occupational hopping. As a consequence of the increase of boundaryless careers in IT, the IT sector might hopefully become more colorful and diverse, and also more inclusive - a true step in the right direction

Late-entry IT professionals. We found that only about 1/3 of late-entry IT professionals remain in the IT sector in the long term. The majority of late-entry IT professionals switched back to their original or another discipline (Prommegger, Weinert, et al., 2020). Companies should, therefore, be aware of the risk of not being able to cover possible transfer costs through late-entry IT professionals in the long term. In order to anchor high-achieving late-entry IT professionals in IT and the organization, organizations should pay particular attention to the entrants' educational backgrounds and previous jobs. Late-entry IT professionals from technical and professional labor professions have low transaction costs to IT jobs, and, therefore, experience easier entry and show long-term persistence in IT. Companies should carefully consider background, knowledge and motivation to make a sustainable decision when hiring late-career IT professionals.

Boomerang IT professionals. Boomerang IT professionals (individuals moving back to IT, after having left IT) are of great value to organizations, as they bring IT and interdisciplinary experience with them (Arnold et al., 2020; Keller et al., 2020; Swider et al., 2017). Therefore, when the opportunity arises, companies should consider hiring boomerang IT professionals or creating career paths within the company that lead boomerang IT professionals back to IT.

Once hired in the IT sector, late-entry and boomerang IT professionals can profit from various benefits in the IT sector, especially from a higher salary (Prommegger, Arshad, et al., 2021). Despite the high demands of IT, late-entry and boomerang IT professionals experience a high level of satisfaction in the long term if the work conditions are set correctly, and the work environment fits their needs.

Women in boundaryless careers in IT. With women making up a recognizable portion of the boundaryless IT workforce, offering late entry into IT or boomerang careers in IT seem promising for increasing the number of women in IT. However, a high proportion of women in boomerang careers might also hint at the family incompatibility of IT jobs, meaning that women might decide to leave the IT sector while having a family. Therefore, we recommend that the boomerang entry of women in IT be examined in the future to make boomerang careers as favorable as possible for both women and organizations.

13.2 Organizational Lifecycle

The organizational lifecycle deals with the perspective of organizations that recruit and employ IT professionals. Accordingly, this level is divided into three phases, in which IT professionals interact with organizations: *Attract, motivate/advance, retain/turnover.*

13.2.1 Attract

In order to assert themselves against the competition in the fiercely contested IT job market, organizations will need to understand the needs, wishes, and plans of the next generation of IT professionals. To answer RQ1, we examined various factors that influence the career decisions of young or prospective IT professionals.

Career anchors. The results show how career anchors influence young IT professionals' job decisions (P1). Young IT professionals are particularly attracted to jobs that promote their technical competence. However, these jobs do not necessarily have to be in high-tech-intensive industries - IT majors are just as likely to start their jobs in non-high-tech industries if they satisfy their desire for technical competence. In addition, IT majors are more willing to change locations for their first job, indicating a lower need for stability.

With these findings, we follow a long tradition of investigating the influence of career anchors in IT (see for example Arnold et al., 2017; Chang et al., 2011; Chang et al., 2012; Taylor & Joshi, 2019). Due to the fast dynamics in the IT environment, career anchors could change fast, especially as the next generation of IT professionals brings a different mindset (Guan et al., 2019; Lyons & Kuron, 2014). Established career anchors, like technical or managerial competence, might fall behind when the IT sector becomes a broader, more diverse sector. Therefore, we recommend continuing the research on the impact of career anchors in IT, considering the different generations currently in the IT job market.

Career success. Traditionally, career success was measured by objective factors, such as remuneration or advancement (Cox & Harquail, 1991; Igbaria & Wormley, 1992; Poole et al., 1993). However, the changing attitudes of young IT professionals are causing subjective factors to become increasingly important for career success. Our results show the increased importance of subjective CSFs for prospective IT professionals, such as compatibility with private life, satisfaction, or meaningfulness (Prommegger et al., 2022b). This indicates that young IT professionals need to be offered a wide range of job characteristics and possibly even career models to make them choose and stay at a company.

Above this, career success dualism, the balance between different, sometimes even competing CSFs, develops as an important phenomenon in the career success literature. Prospective IT professionals do not necessarily demand the extremes of competing CSFs, but rather wish to bring different CSFs into balance (e.g., money & work-life balance). Remuneration and advancement are closely associated with career success dualism, which gives them the status of hygiene factors, which can cause great harm if they are not fulfilled. This finding concludes that young IT professionals seek to be rewarded for the arduous challenge of an IT education and IT career with a much-promised high salary and rapid career advancement.

Flexible career concepts. Current research predicts a change in the mindset of the next generation of professionals in the job market (Guan et al., 2019). In particular, the importance of the single, long-term employer is declining (Briscoe & Finkelstein, 2009; Briscoe & Hall, 2006). In P3, we address the contemporary mindset of the next generation of IT professionals from a boundaryless career perspective (Prommegger et al., 2022a).

While we have already partly discussed these findings at the IT career level, they nevertheless impact the organizational level. First, IT professionals with a boundaryless mindset may need to be approached differently than those with a preference for traditional, vertical advancement. For example, IT professionals with boundaryless mindsets seek constant new experiences and may quickly become bored if these experiences are not created within the organization. These individuals are, therefore, primarily attracted to jobs that involve a high degree of boundary-spanning activities, such as activities in the DevOps team (López-Fernández et al., 2021; Wiedemann et al., 2019; Wiedemann et al., 2020) or job roles in an agile setting, such as Product Owner or Scrum Master (Hoda et al., 2013; Jovanović et al., 2017). Flexible career concepts must be created and advertised within the company to attract boundaryless IT professionals in the future.

IT professionals with a high desire for inter-organizational mobility are attracted by experiences that enable collaboration with other organizations (Briscoe & Hall, 2006). Companies can also create these opportunities by cooperating with other organizations or enabling internal moves, such as via expatriates or subsidiaries. Furthermore, organizations can offer extended unpaid personal time off to enable their employees to follow short-term career development opportunities, such as higher education or training. Organizations will capture the next generation of boundaryless IT professionals by taking such unusual steps.

13.2.2 Motivate & Advance

Modern work practices. Agile practices increase the organizational commitment of IT professionals directly and indirectly (Prommegger et al., 2019). IT professionals in teams using agile practices experience an increased level of supervisor support and at the same time, perceive a higher level of autonomy. While these two constructs may seem contradictory at first glance, they illustrate a precise picture of the empowerment of agile teams, with support but not instructions from the supervisor (Dreßen & Schmid, 2018; Hoda & Murugesan, 2016; Hoda et al., 2013; Shastri et al., 2017). These findings indicate that managers do not become obsolete in agile settings but rather that their roles are shifted. We illustrate the benefits of modern agile principles and show how they positively impact employees' perception of the company. Practicing agile methods and especially living the agile principles can contribute significantly to keeping IT professionals longer in the company.

Training. Constantly changing technical requirements demand that IT professionals be trained regularly, and failure to do so can have damaging consequences for both the organization and the individual (Zaza et al., 2023). While it is clear that organizations need to train their IT professionals (Wingreen & Blanton, 2018), training initiatives can have positive and negative consequences in terms of turnover. On the one hand, training significantly reduces the feeling of perceived obsolescence and increases organizational-personnel fit. On the other hand, training increases the market value of individuals, which can lead to a pull effect on the IT job market (Prommegger, Wiesche, Thatcher, et al., 2020). Organizations are, therefore, advised to plan training initiatives carefully and tailor them to the individual.

The theoretical model in P5 illustrates the key factors which are decisive for how training influences the turnover behavior of IT professionals: the type of training and the type of commitment of the IT professional. Training with portable knowledge will increase turnover risk through external signaling, while non-portable knowledge training will decrease it. In addition, increasing organizational commitment can reduce turnover risk through portable training. In contrast, a high level of professional commitment might enhance the risk of IT professionals using portable training for job hopping to other companies. A carefully developed training plan and measures to increase organizational commitment (e.g., agile practices, P4) can be successful measures to reduce the turnover rate of IT professionals in companies.

13.2.3 Retain & Turnover

Research on retaining and turnover of professionals is challenging to separate, as they both address the same phenomenon (turnover) from different perspectives (reasons for turnover and how to prevent them) (Mitchell, Holtom, Lee, et al., 2001). Therefore, we will discuss both sets of topics jointly within this dissertation.

This dissertation joins longstanding research in the field of IT careers that has been looking at resignations in IT from different angles and theories for many years (Joseph et al., 2007; Zaza et al., 2023; Zylka & Fischbach, 2017). Organizations can draw on supposedly simple but effective methods for turnover management, many of which have been studied in both the general and IS domains (Allen et al., 2010; Pflügler et al., 2018).

External shocks. The COVID-19 19 pandemic acted as an external shock that significantly impacted IT professionals' willingness to leave their jobs (Prommegger, Thatcher, et al., 2021). Being affected by the sudden contextual changes due to the pandemic, IT professionals put their career decisions on hold. As a result, turnover intention decreased significantly. In addition to lower turnover intention, IT professionals significantly changed their perceptions of the company and the IT profession.

These findings show how quickly IT professionals' career plans and perceptions can change due to sudden events (shocks). While shocks have primarily been studied as events that trigger turnover (Burton et al., 2010; Holtom et al., 2017; Kulik et al., 2012), the COVID-19 pandemic shows an exceptional case of a jarring event that does not increase turnover but reduces it.

Crisis management. The study results in P6 show that IT employees were significantly responsive to corporate crisis management. Both affective commitment and person-organization fit increased significantly during the pandemic as companies announced that employees would be given more flexibility during the pandemic. In addition, we also found a sharp increase in professional commitment, which we explain by the comparative ease of switching to work-at-home jobs and the job security that the IT profession brings, even in times of crisis. The results, therefore, illustrate how companies with positive crisis responses can contribute to increased employer perception and a better fit between person and organization, significantly reducing the risk of employees leaving their jobs in times of crisis.

13.3 The Relevance of Context

Context as a much-discussed topic in IS research (Cheng et al., 2016; Davison & Martinsons, 2016) also finds its appropriate consideration in this dissertation. In P6, we discuss how the contextual change caused by the sudden environmental and social impacts due to the COVID-19 pandemic has affected the author's research. From this publication, we can also deduce how decisively contextual change affects IT professionals and IT job markets.

In this dissertation, we illustrate the impact of sudden contextual changes due to COVID-19 on IT professionals on their short- and long-term career plans, for example, through an increase in uncertainty and a decrease in planning certainty. The results of the publication illustrate rapid changes in IT professionals' attitudes toward their organizations. These changes indicate that contextual changes can strongly influence established research models and that established, and heavily tested relationships of influences on the job markets are no longer applicable. With this research, we provide insights into the context sensitivity of IS theories. Thus, we strongly suggest considering context changes in theory as well as in practice.

14 Limitations

Like all scientific research, this dissertation is subject to limitations. These limitations are primarily related to the scope of the dissertation, the choice of research methodology and perspective following the post-positivism paradigm, the operationalization, and the choice of data in the studies. In the following, we describe these limitations in detail.

Due to the time constraints of this dissertation and the complexity of the topic, narrowing the scope of this dissertation down to specific questions was essential from the beginning. The chosen research questions limited the scope of this dissertation and caused it to leave out potentially essential topics and influences related to the career mobility of IT professionals. For example, headhunting (Lee et al., 2008) - a common approach in the job market - remains undiscussed in this dissertation. Also, the influence of different employment settings common in IT, e.g., outsourcing (Lacity et al., 2009), still needs to be investigated. Finally, the influencing factors in the derived research model may reveal gaps since, as described above, it is impossible to provide a holistic representation of the career mobility and career decisions of IT professionals in the scope of one dissertation. Given these limitations, the results of this dissertation are to be interpreted accordingly.

Another limitation is the choice of perspective from a post-positive paradigm (Gefen, 2019) and research methodology, primarily oriented toward quantitative methods. In following quantitative research designs, we follow a longstanding tradition in the IT workforce research community, which is highly engaged in quantitative studies (Wiesche et al., 2020; Zaza et al., 2023). By its very nature, a quantitative research design requires a precise, predefined limitation of the study, which restricts the ability to identify unobserved influences in models that would have been possible, for example, through a qualitative approach (Venkatesh et al., 2013). Therefore, this dissertation's methodology primarily focuses on testing and strengthening existing theories rather than developing new ones, which can be seen as a limitation of the dissertation. Nevertheless, we see the main contribution of this dissertation in combining and contextualizing theories, adapting them to the IT environment, and testing to what extent they are valid in the IT context (Hong et al., 2013).

A further limitation of this dissertation arises from the data sets adopted in the individual studies. We note that the operationalization of variables, especially regarding archival data, as in P1, P7, and P8, can significantly impact the results of the analyses and must be considered accordingly. However, we have taken the greatest care in the selection of the variables as well as in the operationalization and have always completed both based on the strictest theoretical foundation. Nonetheless, we ask to keep this limitation in mind when interpreting our findings and call for future research to test our models with alternative variables and operationalization. Furthermore, the choice of target group may have affected our results. In our studies, we generally refer to IT professionals, a rather broad term defined differently by various studies. In conducting our studies and collecting data, we always classified IT professionals by categories to ensure a clean data sample. Nevertheless, we must point out that all our samples of IT professionals are combinations of several IT jobs. This mix could affect the results

accordingly. We, therefore, call for the studies to be tested with different subcategories of IT professionals.

Finally, we would like to point out that our studies entail a national context through the choice of data collection locations, which might have affected our results considerably. In this dissertation, we have focused explicitly on German samples, with a few exceptions being US and UK samples. We point out that the job market, the legal situation, as well as cultural differences in Germany might be strongly reflected in the results of the studies, especially when it comes to laws and regulations such as employment protection and notice periods. We urge to keep this German context in mind when interpreting this dissertation's findings and call for future replication of the studies in other national contexts.

15 Implications

This dissertation provides numerous links to existing research by confirming, extending, and contextualizing IS and HR theories. Table 15 gives an overview of the most important contributions, which we present in detail in the following.

15.1 Implications for Theory

Specifics of the IT profession. We consider a major theoretical implication of this work to be the confirmation and extension of IS literature dealing with the specifics of the IT profession. We thus confirm and extend research that highlights the specific context of IT professionals, such as Guzman et al. (2008); Riemenschneider and Armstrong (2021); Zaza et al. (2023) that deals with the elaboration of the specific culture in and specific characteristics of the IT profession. In this dissertation, we demonstrate 1) that HR theories can be applied to the study of IT professions, but also 2) that they need to be contextualized in order to consider specific factors impacting the IT job market and IT professionals. The Specific Findings column in Table 15 provides an overview of the different facets of this particular context and shows influencing factors that have more or less an effect on the IT profession and its job market.

We want to highlight the particular context of the power imbalance in the job market in favor of IT professionals. This imbalance becomes evident in that IT professionals usually are free to choose their employers and at the same time, set high standards for their job characteristics and development opportunities (P1 - P4). Furthermore, the imbalance is reflected by the low barrier of turnover of IT professionals (P4 – P5), even in times of crisis (P6). Finally, the dissolution of the boundaries of the IT job market and the resulting reduction in the cost of transfer between professions, both in and out, will be particularly evident in the next few years and with the next generations of IT professionals (P7+8).

Emphasizing the specific context of the IT profession forms the foundation of the legitimation of IT workforce research. With this dissertation, we support a better understanding of the specifics of IT professionals.

Table 15: Implications for Theory

Literature and Theory	Contribution	General Finding	Specific Finding
Specifics of the IT profession (Guzman et al., 2008; Riemenschneider & Armstrong, 2021; Zaza et al., 2023)	Confirm + Extend	The IT context has specific characteristics that cause IT professionals to be more or less affected by particular influences. This specific context must be considered in the application of theories.	P1: Young IT professionals prefer jobs with technical competence and require less geographical stability. P2: Due to high payments in IT jobs, remuneration works as a hygiene factor for young IT professionals. P3: The concept of a boundaryless mindset has stronger impacts on young IT professionals compared to other groups, due to low transactional costs when switching organizations/professions. P5: Due to the fear of obsolescence, training heavily impacts the career mobility of IT professionals. P6: Due to the many job alternatives, IT professionals experience a high degree of ease of movement, even in times of crisis. P7+8: Due to high transaction costs into IT, entry into IT used to be difficult. With the blurring of the IT professional, the sector might become more open.
Recruiting IT professionals (Agarwal & Ferratt, 2002; Ge et al., 2015; Thatcher et al., 2012; Weitzel et al., 2009)	Confirm + Extend	The next generation of IT professionals must be recruited with diverse hiring strategies.	P1: Young IT professionals respond to contemporary career anchors. They prefer jobs with technical competence and require less geographical stability. P2: Young IT professionals need to be offered a wide range of different job benefits and career models in order to make them choose and stay at a company. P2: Remuneration should be seen as a hygiene factor that can have devastating consequences if not addressed when hiring young IT professionals. P3: Jobs that involve a high degree of boundary-spanning activities must be created and advertised in order to attract boundaryless IT professionals in the future.

Literature and Theory	Contribution	General Finding	Specific Finding
IT careers (Jiang et al., 2018; Joia & Mangia, 2017; Joseph et al., 2012; Taylor & Joshi, 2019)	Confirm + Extend	The next generation of IT professionals follows patterns of IT careers that are becoming more diverse and open.	P1: Young IT professionals pursue more management jobs in the IT field. P3: A high proportion of young IT professionals consider job and occupational hopping in their careers. P7 + P8: The rigid boundaries of the IT profession will increasingly disappear, allowing more movement between occupations.
Turnover of IT professionals (Joseph et al., 2015; Joseph et al., 2007; Maier et al., 2015; Zaza et al., 2023).	Extend	The turnover of IT professionals is influenced by specific factors.	P3: A boundaryless mindset influences the turnover behavior of IT professionals. P4: Work practices influence the turnover behavior of IT professionals. P5: Training influences the turnover behavior of IT professionals. P6: External shocks affect the turnover behavior of IT professionals. P6: Contextual changes affect the turnover behavior of IT professionals.
Boundaryless careers (Guan et al., 2019; Sullivan & Arthur, 2006)	Contextualize	The IT profession is changing to a boundaryless profession that allows a growing degree of career switches to and from the outside.	P7: Due to high transaction costs into IT, entry into IT is difficult and often unsuccessful. P3 + P7 + P8: The rigid boundaries of the IT profession will increasingly disappear, allowing more movement between occupations.

Recruiting IT professionals. Another theoretical implication of this dissertation is the expansion of theories on recruiting IT professionals (Agarwal & Ferratt, 2002; Ge et al., 2015; Thatcher et al., 2012; Weitzel et al., 2009). We extend this research by adding aspects of how the next generation of IT professionals needs to be addressed in the job market. Specifically, we show that young IT professionals respond to career anchors differently than previously researched (Arnold et al., 2017; Chang et al., 2012). Compared to previous studies, young IT professionals now prefer jobs with technical competence and require less geographical stability. Furthermore, by extending the research on remuneration in IT (Ge et al., 2015; McLean et al., 1996; Slaughter et al., 2007), we show that financial compensation and career development will no longer be enough to attract IT professionals. Instead, these CSFs should be considered as hygiene factors that can cause great harm if not met. Finally, companies need to offer a wide range of job benefits and career models to attract boundaryless IT professionals in the future.

IT careers. This dissertation extends our theoretical understanding of IT careers (Jiang et al., 2018; Joia & Mangia, 2017; Joseph et al., 2012; Taylor & Joshi, 2019). We demonstrate that the next generation of IT professionals follows patterns of IT careers that are becoming more diverse and open. We observe growing movements between organizations and even professions in the IT job market. Furthermore, we see young IT professionals pursuing more management jobs in the IT field. Consequently, we expect the rigid boundaries of the IT profession to disappear, allowing more movement between occupations. As a result, a significant change in career development in IT can be expected, resulting in a change in IT jobs. Through these findings, we significantly broaden our understanding of modern IT careers.

Turnover of IT professionals. With research question 2, we broaden our understanding of IT turnover (Joseph et al., 2015; Joseph et al., 2007; Maier et al., 2015; Zaza et al., 2023). Turnover of IT professionals is influenced by certain factors, only some of which we can discuss in this dissertation: work practices (P4), training (P5), and external shocks (P6). We demonstrate how IT professionals can be retained by offering modern work practices such as agile practices and show that training can have both a retaining and a repelling effect for IT professionals in their organizations. Using the COVID-19 pandemic, we discuss how external shocks can not only drive turnover intention but also reduces it. As contextual change plays a crucial role in these relationships, context should be considered a driving factor in IT workforce research.

Boundaryless careers. This dissertation proves that the concept of boundaryless careers (Guan et al., 2019; Sullivan & Arthur, 2006) finds relevance in the IT environment. Due to the softening of the boundaries of the IT environment through jobs at the edge of the IT job, an increased number of people who find themselves in the vapor of the IT profession and migrate in and out of it regularly. Thus, the boundaryless career concept is becoming tangible in IT.

15.2 Implications for Practice and Answers to Research Questions

This dissertation was essentially shaped by the goal to derive practical recommendations. It is, therefore, particularly important for us to provide companies with concrete recommendations for dealing with IT skills shortage. In the following, we present these recommendations.

RQ1: How can companies attract young IT professionals who pursue contemporary career concepts?

Table 16 provides an overview of measures for attracting young IT professionals.

Career anchors. To attract the next generation of technical-oriented IT professionals, we recommend offering jobs that improve young IT professionals' technical competence. Furthermore, companies should use young IT professionals' willingness to move for their jobs. Broadening the recruiting area, especially with modern work arrangements such as remote work, will result in a bigger pool of candidates. Additionally, young IT professionals currently do not prefer jobs in big companies or the high-tech intensive industry. Addressing the need for technical competence, we recommend that high-tech companies improve their recruitment techniques for young IT professionals by advertising work at cutting-edge technology. For small and medium enterprises (SME), we recommend advertising their flexibility and autonomy compared to large companies.

Table 16: Recommendations on Measures to Attract Young IT Professionals

Target Group	Measure
Next generation of IT professionals	**Career Anchors:** Consider the career anchors of young IT professionals - Offer jobs that improve the professionals' technical competence. - Use young IT professionals' willingness to move for their jobs. Broaden your recruiting area. - Make increasing use of career changers to address the shortage of IT specialists. - Start interacting with potential employees early in their careers, ideally during their studies. - SME: Take advantage of the fact that young IT professionals do not prefer large companies for their first job. - High-tech companies: Improve recruitment techniques for young IT professionals by advertising work at the cutting edge of technology.
	Career Success: Consider the expectations of perceived career success of young IT professionals - Evaluate the career goals of young IT professionals and jointly design career development plans. - Offer opportunities to fulfill a combination of subjective and objective CSFs. - Emphasize the fulfillment of subjective career success factors. - Address remuneration and promotions as hygiene factors. - Offer contemporary career paths to attract young IT professionals and improve gender balance in IT.
Boundaryless IT professionals with a desire for interdisciplinary experiences	**Address the desire for interdisciplinary experiences** Consider the needs of boundaryless IT professionals - Offer a wide range of development possibilities and career models in the organization. - Offer career paths with interdisciplinary switches within the company. - Offer interdisciplinary tasks and boundary-spanning activities in and outside of IT. - Offer IT jobs with plenty of interactions with other disciplines. - Build fast-paced, flexible, and interdisciplinary groups (e.g., agile teams).
Boundaryless IT professionals with a desire for inter-organizational experiences	**Address the desire for inter-organizational experiences** Consider the needs of boundaryless IT professionals - Offer experience outside the organization (e.g., subsidiaries, expat assignments, sabbaticals, training, or similar) in combination with flexible re-entry. - Offer boomerang and management entries for IT professionals. - Plan inter-organizational experiences jointly with employees.

Career success. The perception of career success is changing significantly among the next generation of professionals (Guan et al., 2019; Spurk et al., 2019). Therefore, we recommend regularly evaluating young IT professionals' career goals and jointly designing development plans. The career plans of the next generation of IT professionals often involve a combination of multiple CSFs for which employees may be willing to compromise (Prommegger et al., 2022b). Thus, we recommend offering combinations of subjective and objective CSFs that benefit both the employer and the employee. Remuneration still seems to be one of the decisive factors for career success. Thus, we recommend addressing remuneration as a hygiene factor, which needs to be met in order to attract and keep IT professionals in organizations. Finally, an

increase in the importance of subjective CSFs could lead to a more diverse range of career paths, including horizontal movements between organizations, especially for women in IT. Therefore, we recommend that companies offer contemporary career paths to attract young IT professionals and improve gender balance in IT.

Boundaryless IT professionals with a desire for interdisciplinary experiences. The IT profession is becoming less restricted and is, therefore, attracting an increasing number of boundaryless employees in IT. Companies must expect an increased desire for interdisciplinary and inter-organizational experiences among their IT professionals. Therefore, we recommend offering a wide range of development opportunities and career models within the company that allows a high degree of flexibility among IT professionals. Specifically, we recommend offering career paths with interdisciplinary rotations within the company to satisfy the desire for interdisciplinary experience. We also recommend offering interdisciplinary assignments and boundary-spanning tasks within and outside of IT to keep boundaryless IT professionals in the company. At the task level, we recommend offering IT jobs with plenty of interaction with other disciplines and creating fast-paced, flexible, and interdisciplinary groups.

Boundaryless IT professionals with a desire for inter-organizational experiences. Meeting the desire for inter-organizational mobility will become a challenge for companies. We thus recommend using the broad skill set of these IT professionals and addressing the desire for inter-organizational experience within the company instead of trying to suppress it. Companies should therefore start to offer off-site experience (e.g., subsidiaries, expat arrangements, sabbaticals, advanced training) and flexible re-entry afterward. This measure will satisfy the desire for cross-organizational experience and attracts boundaryless IT professionals without losing them to the following organization.

RQ2: How can companies prevent the turnover of highly qualified IT professionals in a dynamic work environment?

Table 17 provides an overview of the measures that companies can take to retain IT professionals. In our studies, we have found that work practices, career development strategies and crisis management influence the risk of employee turnover.

Work practices. Increasing the person-organization fit is crucial when using working practices to reduce turnover risk, meaning that work practices must match the employee's values and image system. We tested this theory using the example of agile practices (Prommegger et al., 2019). We showed that agile practices increase IT professionals' organizational commitment by providing them with higher autonomy and increased supervisor support. Thus, we recommend the evaluation and adaptation of contemporary work practices in the company to increase the person-organization fit and bind the employee to the company through organizational commitment.

Table 17: Recommendations on Measures to Retain Key IT Professionals

Target Group	Measure
Key IT professionals	**Work practices** Offer contemporary work practices that meet the IT professional's system of beliefs and images, such as agile methods.
	Career development strategy Consider employee advancement and development as one of the deciding factors for turnover or retention of IT professionals. - Jointly develop a training plan to combat perceived obsolescence. - Evaluate organizational and professional commitment and generate a development plan that supports both forms of commitment without driving employees into the job market. - Alternate training that promotes portable knowledge with training that promotes non-portable knowledge.
	Crisis management Recognize that times of crises can highly impact the turnover behavior of IT professionals. - Lead IT employees through times of change and guide how to handle change. - Develop measures to reduce uncertainty in the organization. - Give IT professionals more freedom in times of uncertainty. - Pay attention to regular communication. - Make use of the IT profession's advantages (virtual + fast collaboration, agility, modern mindsets) and let your IT professionals benefit from these advantages.

Career development strategy. A well-designed career development strategy for IT professionals should form the basis for the long-term retention of IT staff (Ferratt et al., 2005). This strategy should involve development and training opportunities within and outside the company. We recommend working with IT professionals to design professional development plans that address the needs of different skill demands. As training can be both binding and off-putting simultaneously (Green et al., 2000; Sieben, 2007; Wingreen & Blanton, 2018), we recommend caution when planning extensive training. We suggest alternating training that promotes portable knowledge with training that promotes non-portable knowledge to avoid driving IT staff into the IT job market through external signaling. In addition, we recommend regularly evaluating the IT professional's organizational and professional commitment and designing a development plan that supports both forms of commitment. These measures will increase person-organization fit (Wingreen & Blanton, 2018) to buffer the negative effects of increasing the IT professional's market value through training.

Crisis management. The COVID-19 pandemic has taught us that crises can have a significant impact on us as individuals but also as professionals. In our paper on the COVID-19 pandemic, we show that turnover plans and perceptions of the organization and the IT profession changed significantly during the onset of COVID-19. Organizations can significantly influence these plans and perceptions and use times of crisis to maintain or even improve their relationship with their employees (Hamouche, 2021). We recommend several actions to help IT professionals pass through times of change and crises. Specifically, we recommend introducing change management within the company to guide IT professionals through times of change and advise them to deal with change (James et al., 2011). Specifically, organizations should develop measures to reduce uncertainty and support employees. This means ensuring regular,

transparent communication and providing guidelines but also autonomy. Autonomy is necessary for IT professionals to react to challenges flexibly and simultaneously increases the perception of the company and the person-organization fit.

RQ3: Which alternative ways to fill vacant IT positions are most beneficial for companies and employees?

Table 18 provides recommendations on the integration of late-entry and boomerang IT professionals in organizations.

Late-entry IT professionals. Late-entry IT professionals can be valuable resources for organizations if carefully selected during the hiring process. Since many late-entry IT professionals tend to return to their original disciplines (Prommegger, Weinert, et al., 2020), we recommend checking the background and motivation of late-entry IT professionals thoroughly before hiring. Late-entry IT professionals from technical and professional labor professions have low transaction costs to IT jobs and, therefore, experience easier entry and show long-term persistence in IT. In addition, the high salary and the good IT job market should not be the deciding reason for a career change. Instead, late-entry IT professionals should want to enter IT for reasons of technical affinity and curiosity.

For the introductory phase of late-entry IT professionals in companies, we recommend holding introductory courses or boot camps that introduce late-entry IT professionals to the organization-specific IT infrastructure. To support rapid onboarding, late-entry IT professionals should be integrated into strong, established teams with appointed team members who act as mentors in the career transition phase. Furthermore, we recommend creating a network within the company where late-entry IT professionals can exchange ideas and experiences. After a successful onboarding period, we recommend investing in continuous training for late-entry IT professionals and setting up training plans to ward off the feeling of obsolescence and boost self-confidence.

Boomerang IT professionals. Boomerang IT professionals are considered great added value for companies, as they bring a large and diverse skill set (Arnold et al., 2020; Keller et al., 2020; Swider et al., 2017). This applies to both boomerang IT professionals returning to a company (Maier et al., 2021) and boomerang IT professionals returning to the IT profession (Prommegger, Arshad, et al., 2021). Therefore, we recommend strengthening the company's relationship with boomerang IT professionals to benefit from their skill set. Specifically, rather than simply tolerating the exit and re-entry of employees, we recommend working with the boomerang IT professional to develop plans for re-entry into the organization. Companies should develop strategies that address boomerang IT professionals' desire to leave and re-enter the company/profession. For example, companies can offer experiences outside the company (e.g., branch offices, overseas assignments, training) with the option of flexible re-entry. Furthermore, organizations should allow for flexible, unpaid leave so IT professionals can pursue interdisciplinary interests or further education and training.

Table 18: Recommendations on Alternative Ways to Fill Vacant IT Positions

Target Group	Measure
Late-entry IT professional	**Successful onboarding of late-entry IT professionals** Consider hiring late-entry IT professionals to tackle the IT skills shortage. - Thoroughly screen the background and motivation of late-entry IT professionals before hiring. - Consider an in-house bootcamp, including an introductory phase for late-entry IT professionals. - Integrate late-entry IT professionals in strong, established teams and let them learn along. - Nominate a mentor for late-entry IT professionals. - Create a network of late-entry IT professionals in the company. - Give late-entry IT professionals time to settle in. - Invest in late-entry IT professionals' continuous training. - Embed late-entry IT professionals as much as possible in the organization and the IT profession.
Boomerang IT professionals	**(Re-) Hiring boomerang IT professionals** Aim at hiring boomerang IT professionals to profit from their broad skill set. - Be open to exit and re-entries of boomerang IT professionals (exit and re-entry into the organization and the profession) - Create and develop strategies that address the desire of boomerang IT professionals to leave and reenter the organization/profession. - Offer interdisciplinary experiences outside the organization (e.g., subsidiaries, expat arrangements, training, or similar) and flexible re-entry. - Allow for flexible, unpaid leave so that IT professionals can pursue interdisciplinary interests (e.g., training)

16 Potentials for Future Research

This dissertation offers many points of reference for further research, which can be found in detail in the individual papers. However, we would like to highlight three topics that are considered particularly promising for future research in the IT context: 1) Exploring how to retain IT professionals in a highly dynamic environment, 2) examining the new IT workforce after the COVID-19 pandemic, 3) investigating the potential of late-entry IT professionals in the IT sector. In the following, we will go into the research fields in detail.

16.1 Retaining IT Workforce in a Highly Dynamic Environment

The progress of digitalization and the constant advancement of technological innovations lead to a faster and more demanding work environment for IT professionals (Niederman et al., 2016). Many job alternatives and a highly dynamic work environment make the IT sector an ideal setting for job hopping - meaning that IT professionals change quickly between jobs and organizations. To be competitive, companies need to retain skilled IT professionals in the long term. For this reason, we call for further research in the following area:

Building resilience in the IT sector. With many job alternatives and a high workload, the IT job market shows characteristics conducive to jarring events, which might lead to impulsive turnover decisions (Niederman et al., 2007). While within this dissertation, we have demonstrated the influence of COVID-19 as an external shock, we need an understanding of classical shocks according to Lee et al. (1999) in IT. We recommend investigating to what extent the IT environment functions as an incubator for shocks and how IT professionals can build resilience against them. Furthermore, we call for future research on IT-specific shocks, namely shocks that either a) occur exclusively in the IT environment (e.g., the release of a software update), b) frequently occur in the IT environment (e.g., IT project failure), or c) that causes a large part of the turnover in the IT environment (e.g., problems in the cooperation with customers). Finally, researchers should create a better understanding of how IT professionals can build resilience against jarring events. While this dissertation focuses on modern work practices, training, and crisis management to retain IT professionals in organizations, many more factors bind IT professionals to their organizations. The theories around job embeddedness provide a good starting point to investigate these.

16.2 New IT Workforce After the COVID-19 Pandemic

The COVID-19 pandemic has significantly impacted the IT profession and the IT labor market. Work practices have changed toward hybrid or remote work environments, the IT labor market has gone global, and a new generation of IT professionals is taking advantage of this newly developed freedom. It is, therefore, vital to examine how the COVID-19 pandemic has affected IT work and the IT labor market and what a post-COVID-19 IT workforce and IT jobs market might look like. Specifically, we call for the following future research areas:

The COVID-19 crisis as a game changer for IT work and the IT job market. The COVID-19 crisis and especially the rapidly resulting changes in work practices have taught us new forms of collaboration (Waizenegger et al., 2020). The following years will reveal how the

change in these work practices affects our perception of the job, our relationship with our employer, and our workplaces. Based on our contextual change study (P6), we call for research that examines the COVID-19 crisis as a game changer for IT work and the IT job market. In particular, we are interested in how IT teams will work together in the future and to what extent research on virtual teams applies to these new collaboration models. Furthermore, we recommend investigating how the new work practices affect concepts like job embeddedness and organizational commitment in the IT context and how IT professionals can be bound to organizations when they work location-independently. Lastly, we are interested in whether IT professionals are influenced by different factors when choosing their jobs than they were before the COVID-19 pandemic.

The COVID-19 crisis as a game changer for the next generation of IT professionals. With the advancement of contemporary values with the next generation of workers (Guan et al., 2019), and the current changes due to the COVID-19 pandemic, we expect modifications in the work of the next generation of IT professionals. As anchored in several studies in this dissertation (P2, P3, P7, P8), we believe that more boundaryless professionals will find their way into the IT sector in the future. Furthermore, young IT professionals will have the opportunity to anchor their values more firmly in their work and to choose their jobs accordingly due to the ongoing high demand for IT professionals. We, therefore, call for an extension of our studies (P2 + P3) to examine the specifics of the contemporary mindset of prospective IT professionals, how it will shape the IT job market in the future, and how companies can prepare for a possible increase in mobility in the IT job market.

16.3 Late-entry IT Professionals

With the opening of the IT sector, we expect an increase in interactions of the IT department with other departments, more boundary-spanning activities in IT, and an increase in mobility in IT careers. This increase in mobility is very well reflected in the literature on turnaway from IT (Brooks et al., 2015; Joseph et al., 2015). Mostly overlooked, however, is the study of late-entry IT professionals, i.e., professionals without an IT background moving into the IT sector. Through our investigation of the diverse careers of boundaryless IT professionals, we see late-entry IT professionals as a potential resource for combating the IT skills shortage; given they are well prepared for the entrance and companies take enough time and effort to onboard this group into the IT profession successfully. At the same time, we see this research field as a significant gap in the IT workforce research field that requires more attention. Specifically, we propose the following research areas related to late-entry IT professionals:

The typical careers of late-entry IT professionals. To continue our studies (P7 + P8), we recommend a more detailed investigation of the typical careers of late-entry IT professionals. In this context, an investigation of the career path prior to entry into IT is particularly promising to understand which groups of professionals are well suited for a late-entry into IT. Furthermore, in our ongoing studies on late-entry IT professionals, we see that the personal reasons and motivations for the entry of late-entry IT professionals significantly impact their success in the IT sector. We, therefore, recommend a more detailed investigation of the reasons for late-entry into IT and to assess which drivers best support a successful entry as well as advancement in IT.

The onboarding and development of late-entry IT professionals. It is essential to onboard late-entry IT professionals correctly in the company, as well as in projects, in order for them to survive the difficult transaction phase. Researchers should, therefore, take a closer look at how late-entry IT professionals need to be appropriately introduced into companies so that they can contribute productively to the success of projects and the company. In order to keep late-entry IT professionals in the company, they should be coached and promoted on an ongoing basis. Researchers in the future should investigate how late-entry IT professionals can be guaranteed career development opportunities in the company so that they can establish themselves in the company.

Failed late-entry IT professionals. Finally, we recommend examining failed late-entry IT professionals and their path back to their discipline of origin or some other discipline. Researchers should take a closer look at the development of late-entry IT professionals, their motivation for the entrance, and their experiences in the IT sector. Based on these studies, companies will better understand how they should select their late-entry IT professionals, how they should onboard and integrate them, and how they should promote them to keep these people in the company and in the IT profession for as long as possible.

Finally, for the sake of completeness, we would like to mention several possibilities for future research based on the limitations of the individual studies in this dissertation. These possibilities can be found in chapter 14 Limitations in detail. To address the limitations of our studies, we call for

1. qualitative and in-depth investigation of our results in order to generate new aspects of the used theories,
2. conducting the studies with other data samples, especially with subcategories of IT professionals, in order to identify differences within the IT profession, and
3. replicating the studies in an international context.

17 Conclusion

This dissertation was motivated by the high demand for IT professionals and the need for researchers and practitioners to work together on finding solutions to tackle the IT skills shortage. We explored three different approaches to combating the IT skills shortage: attracting young IT professionals, retaining key IT professionals, and engaging boundaryless IT professionals in the IT sector. The results of the dissertations illustrate how the next generation of IT professionals brings a modern mindset with them; therefore, companies need to provide various career opportunities and benefits to meet the career aspirations of young IT professionals. We also show how work practices, work environments, and the training of IT professionals can bind IT professionals to their companies. Finally, we provide recommendations on how late-entry IT professionals can be sensibly integrated into the company so that they remain with the company and IT in the long term. We show links to different IS and HR theories in the area of HRM of IT professionals and give concrete recommendations for addressing the IT skills shortage. We conclude with an outlook on how future research in the area of resilience, the future of IT workforce, and late-entry IT professionals can build on and extend our research.

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19 Appendices

WHAT ATTRACTS THE NEW GENERATION? CAREER DECISIONS OF YOUNG IT PROFESSIONALS

Research paper

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Abstract

The shortage of IT specialists calls for the entry of more young workers into the IT profession. However, little is known about young IT professionals in their early career stages. Our study, therefore, aims for a better understanding of career decisions of young IT professionals by looking at (1) patterns in contemporary IT careers, (2) the influence of career anchors in early IT career stages, and (3) the compensation of young IT professionals. We studied the career decisions of 243 IT professionals in the US, born between 1980 and 1985. The results illustrate the boundaryless IT profession and show that persistence in IT careers is related to the choice of the first job. Furthermore, whereas there was no evidence for the attractiveness of high-tech industries and small companies, IT graduates filled significantly more jobs that help evolve technological competence and were more willing to move for their first jobs. Finally, while individuals who started in IT did not have higher salaries compared to those starting in other sectors, persistence in IT was financially rewarded in the long-term. Our study provides an improved understanding of the career decisions of young IT professionals and thus helps to acquire and retain talent.

Keywords: IT Labor Market, IT Graduates, Career Anchors, Career Paths

1 Introduction

The rapid progress in digitization and the increase in technology in companies make the IT profession indispensable in almost all industries (Dinger et al., 2015). The resulting high demand for IT specialists who can analyze, design, implement, support and manage computer-based information systems (Goles et al., 2008) is leading to a steady increase in the number of vacancies. In the US, the number of IT jobs is expected to increase by 11% by 2028 (Bureau of Labor Statistics, 2019b), which equals 46,800 new jobs for the IT workforce. Attracting highly skilled IT professionals will therefore be a driving factor for all types of companies to remain competitive in the future.

This change in the IT labor market is also evident in the evolving character of the IT profession, as well as in the transformation of IT careers. The strong dependence of IT specialists on the technology they work with inevitably causes a constant change in the skill requirements of IT professionals (Tsai et al., 2007). The persistent danger of obsolescence and the natural evolution of IT jobs force IT professionals to constantly adapt their skills, their responsibilities and ultimately their job profiles (Zhang et al., 2012). Furthermore, due to rapid technological change and an ongoing rise in competition, tech companies offer less life-long employment (Ang and Slaughter, 2000). As a result, the IT profession is

becoming more diverse and shows indicators of a so-called boundaryless occupation, supporting careers that involve moves across organizations and professions (Slaughter, 2001).

Whereas traditional IT careers used to be divided as technical and managerial (Chesebrough and Davis, 1983, Ginzberg and Baroudi, 1988), contemporary IT careers follow various directions (Joseph et al., 2012). To explain this new form of job mobility, the theory of career anchors has been proven to be a helpful predictor (Chang et al., 2011). Employees are strongly influenced by career anchors, namely their talents and abilities, attitudes and values, and motives and needs (Schein, 1996). Traditional career anchors like stability, however, are losing importance among young IT professionals in their early career stages, and are being replaced by the desire for flexibility, challenge and experience (Chang et al., 2012). As a result, contemporary IT careers are often tied neither to a single employer, nor to a single profession (Joseph et al., 2012). This leads to a significantly dynamic IT labor market and a great challenge for companies to retain their best talents (Pflügler et al., 2018).

The evolution of the IT profession is an enduring topic in IS research (Wiesche et al., 2019). Due to the transformation of IT careers, it is important to understand the process through which the young generation of IT professionals shapes its job profiles and its careers. With our study we want to provide a better understanding of career decisions of young IT professionals, by (1) examining career paths of young IT professionals, (2) investigating relevant career anchors for first job decisions, and (3) exploring monetary aspects of early IT careers. Our study therefore deals with the following questions:

RQ1: What do contemporary career patterns in IT look like?

RQ2: Which career anchors influence young IT professionals when choosing their first employers?

RQ3: What is the compensation of young IT professionals compared to other careers?

Our study was designed as following: First, we examined the career paths of 243 young IT professionals by replicating the study of Joseph et al. (2012), who had identified three different patterns of career paths in IT. Second, we had a closer look at the job characteristics of the first jobs held by young IT professionals and compared those with the theory of career anchors. Third, we examined the salaries of modern IT careers. The basis of the analysis is the publicly accessible, US American data set NLSY97, which puts our study in the US American context.

2 Theoretical Background

In this section we review relevant literature related to IT career paths, as well as to career anchors in IT. Building on the reviewed literature, we then provide hypotheses on the careers of young IT professionals, as well as on their first job characteristics.

2.1 IT Career Paths

The term career paths is used to describe "models or prototypes characterizing the career sequences of a group of individuals" (Joseph et al., 2012). Early research on IT careers had described IT career paths as mirroring the dual-path concept. IT careers were traditionally classified as either managerial or technical oriented (Ginzberg and Baroudi, 1988, Chesebrough and Davis, 1983). Following this logic, IT professionals would decide to either move up the career ladder by gaining management responsibility or by improving technical skills. However, with the changing IT profession, the typical career patterns have changed. Igbaria et al. (1995) considered the traditional view of technical and managerial IT careers as obsolete. They proposed that IT professionals hold different career orientations which will eventually grow toward different directions. Beginning with these novel declarations, numerous studies have investigated the change of the IT profession from the classic dichotomy to a boundaryless one (Fu and Chen, 2015, Arnold et al., 2017).

Being characterized by frequent turnover within the profession as well as turnaway from the profession (Joseph et al., 2015), the IT career displays typical attributes of boundaryless careers (Ituma and

Simpson, 2009, Slaughter, 2001). A comprehensive description of this phenomenon is provided by Joseph et al. (2012). Joseph et al. (2012) investigated career patterns in IT by analyzing 500 career sequences of US American employees who had worked in an IT job for at least one year between the years 1979 and 2006. They found three different patterns: IT careers, professional labor market (PLM) careers and secondary labor market (SLM) careers. Employees following IT careers entered the IT sector immediately after education and spent a lifetime in it. IT professionals with PLM careers entered the IT market early in their career but then decided to leave for other sectors or managerial positions. IT workers following SLM careers often switched between professions in and outside of IT. Separating IT careers into three forms of career paths contributed to a better understanding of the boundaryless IT profession. While in the past it had been unclear in which directions IT professionals would turnover and turnaway, Joseph et al. (2012) discovered different degrees of boundarylessness within the three career paths. Whereas the IT career was found to be boundaryless across organizations, the PLM and SLM career were boundaryless across occupations (Joseph et al., 2012).

The development of the IT profession into a boundaryless occupation thus presents companies not only with the challenge of binding IT professionals to their company but also of finding young IT professionals with high persistence potential in the IT profession. As not all IT graduates start their work in the IT field (Ge et al., 2015, Setor and Joseph, 2017) it is especially important to set measures to attract young graduates. Companies can implement various measures to achieve this. Above all, early career based interventions like cooperative education, internship, and mentorship increase the likelihood of initial IT employment (Setor and Joseph, 2017). Furthermore, as IT graduates are characterized by high self-evaluating expectations (Heinze and Hu, 2009), entry-level IT professionals tend to positively evaluate IT-oriented companies with good opportunities for development, as well as high compensation (Thatcher et al., 2012). This is also evident in the financial figures. IT professionals are known for having higher starting salaries compared to other occupational groups (Ge et al., 2015, Slaughter et al., 2007).

2.2 Career Anchors

Schein (1996) and DeLong (1982) have identified career anchors as the main influence factors for career-oriented decisions of professionals. Career anchors are described as the individuals' self-perceived talents and abilities, attitudes and values, and motives and needs (Schein, 1996). Schein (1996) has defined eight different career anchors: managerial competence, technical competence, stability and security, autonomy, entrepreneurial creativity, service, challenge and lifestyle. Whereas individuals who identify with managerial competence focus on climbing up the hierarchy ladder, individuals identifying with technical competence want to develop their skills to a high level. Employees looking for stability choose jobs with high job security, while employees preferring independence look for jobs with a high degree of autonomy. Individuals identifying with entrepreneurial creativity or service are motivated by creating their own enterprise or performing a job with a cause. Finally, while employees looking for challenges get engaged by demanding jobs, employees following the career anchor lifestyle prefer jobs with work-life balance (Schein, 1996). Career anchors thus function as a stabilization force, directing the individual's decisions on career movement (Schein, 1996). They have been found to be the driver of a person's career decisions and are therefore a helpful measure for predicting the career movements of IT professionals (Crepeau et al., 1992).

Early research on the influence of career anchors on IT professionals' careers has found technical and managerial competence as the two dominant anchors (Crepeau et al., 1992, Igbaria et al., 1991). This finding supports the concept of the dual-path career as IT professionals preferring technical competence would follow a technical career while those who prefer managerial competence would follow a managerial career. With the transformation of the IT profession into a boundaryless profession, however, more recent studies detect wide ranges of career anchors influencing IT professionals' career decisions. Even though technical and managerial competence still play an important role, IT professionals nowadays are highly influenced by career anchors that promote their personal development (e.g. challenge and independence) (Arnold et al., 2017, Chang et al., 2012, Taylor and Joshi, 2019).

Career anchors are highly dependent on the IT professionals' age and career stages (Chang et al., 2011). While challenge, and technical competence are important within all stages, managerial competence and geographical security gain importance with career progression. These changes are due to evolving expectations and desires as a result of changing environmental and social settings. As these changes appear, IT professionals seek new jobs to fulfill their new expectations and desires around their career anchors, thus leading to turnover or turnaway (Chang et al., 2011).

2.3 Study Design and Hypotheses Development

To better understand contemporary IT careers, we divided our study into two parts. First, we examine the composition of modern IT careers by replicating the study of Joseph et al. (2012). The aim of this approach is to compare Joseph et al. (2012)'s findings with current data and identify differences and similarities. Second, we aim to generate a better understanding of career decisions of young IT professionals by analyzing job characteristics and salaries of their first jobs. In the following section, we present hypotheses that will help in describing the job characteristics of young IT professionals.

- Educational background & first jobs

We propose that the educational background, as well as the choice of the first job work as antecedents for IT focused careers. IT jobs often require a good technological skillset based on a university education with an IT major (Aasheim et al., 2019). During their studies, IT graduates get the necessary skill set to develop IT-specific human capital (Joseph et al., 2010). This IT-specific human capital prepares IT graduates to start their careers within the IT sector in IT-related jobs. In addition, the entry into IT through choosing a first IT job immediately after graduation helps IT graduates to remain loyal to the IT profession. IT graduates with career based interventions are likely to build a salient professional identity to the IT profession and as a consequence show forms of persistence in the IT sector (Setor and Joseph, 2017). Thus, we hypothesize:

H1a: Individuals who choose IT jobs as first jobs are more likely to have higher degrees compared to individuals who choose non-IT-jobs as first jobs.

H1b: Individuals who choose IT jobs as first jobs are more likely to show persistence in the IT sector than individuals who choose non-IT-jobs as first jobs.

- Career anchors & first jobs

We propose that career decisions of IT professionals in early career stages are affected by the career anchors technological competence, challenge and independence. Due to their distinct occupational culture, IT professionals strive for personal growth and challenging tasks (Guzman et al., 2008). When choosing their employers, IT professionals therefore typically follow the career anchors technical competence and challenge (Chang et al., 2012, Arnold et al., 2017). In addition, modern working techniques such as agile methods have become popular among young IT professionals (Przybilla et al., 2018). These techniques support job autonomy and require a dynamic environment without strong hierarchical structures (Moe et al., 2008, Huck-Fries et al., 2019). Young IT professionals therefore look for jobs and companies in which they can realize their aspirations for technological competence, challenge and independence. Whereas these career anchors are already active in the early career stages, geographical security, however, only becomes relevant in later career stages (Chang et al., 2011). Following this logic, we suggest that IT graduates look for IT jobs (career anchor: technical competence), preferably in small companies (career anchor: independence), which operate in high tech-intensive industries (career anchor: challenge). However, due to their low desire for geographical security (career anchor: stability), IT graduates are more willing to move for their first job. Thus, we hypothesize:

H2a: 'Technical competence': Individuals with IT major background are more likely to choose IT jobs as their first job compared to individuals with non-IT major background.

H2b: 'Challenge': Individuals with IT major background are more likely to choose high-tech intensive industries for their first jobs compared to individuals with non-IT major background.

H2c: 'Independence': Individuals with IT major background are more likely to choose small companies for their first jobs compared to individuals with non-IT major background.

H2d: 'Stability': Individuals with IT major background are more likely to migrate for their first jobs compared to individuals with non-IT major background.

- Compensation & first jobs

We suggest that IT professionals entering IT right after graduation have a financial advantage over IT professionals choosing other jobs as their first jobs. Due to rapid technological change, high skilled IT professionals are essential to the success of organizations. Consequently, companies are paying good wages to attract and retain well-educated IT professionals (Ang et al., 2002, Setor and Joseph, 2016). Consequently, the starting salaries of IT graduates who choose IT jobs are higher compared to those who enter non-IT jobs (Ge et al., 2015). Furthermore, not only starting with an IT job, but also persistence in the IT career is rewarded financially. IT professionals with a focus on technology are among the best paid employees (Slaughter et al., 2007). We therefore assume that IT professionals who stay in IT careers will earn better than those who choose to change their career later. Thus, we hypothesize:

H3a: Individuals who choose IT jobs as their first job have higher salaries compared to individuals who choose non-IT jobs as their first jobs.

H3b: Individuals who choose IT jobs as their first job and stay in IT careers will have higher salaries compared to individuals who change their career focus later.

3 Research Method

3.1 Data Collection and Preparation

To analyze the career paths of young IT professionals, we applied an inductive and quantitative approach replicating the study of Joseph et al. (2012). The individual longitudinal workforce data was collected from NLSY97 from Bureau of Labor Statistics (BLS). The NLSY97 is a longitudinal program from BLS that surveyed 8984 US Americans born between 1980 and 1984. Respondents are surveyed about a broad range of topics covering information on household, family, health, education and employment. This ongoing program ran annually from 1997 to 2011 and has been conducted biennially since then. 17 rounds of survey data were available by the time of data collection for this study.

For data sampling, we followed the process suggested by Joseph et al. (2012). As a first step, we assigned the occupations' code according to the coding data. This means that each individual has been assigned an occupation code for each year of the study. Following the coding schema of Joseph et al. (2012), we coded each respondent's job from 1997 to 2015 using the codes provided in Table 1. Technical IT (I) and managerial IT (M) were labeled as IT jobs. All other jobs were labeled as non-IT.

Label	Jobs	Code	Jobs	Code
IT Job	Technical IT job Example: software engineer	I	Managerial IT job Example: IT project manager	M
Non-IT Job	Non-IT managerial job Example: sales manager	G	Non-IT professional job Example: teacher	P
Non-IT Job	Clerical job Example: office worker	C	Technical administration job Example: data entry clerk	J
Non-IT Job	Craft, production and service job Example: food worker	O	Sales job Example: retail salesperson	S
Non-IT Job	Technician Example: engineering technician	T	Military service, in school, part-time and unemployed	Y,X,Z

Table 1. Codes for jobs in NLSY97 (based on Joseph et al. (2012))

Initially, the NLSY97 sample contained 8984 respondents' data, covering the years from 1997 to 2015. After coding the jobs, we reduced our sample to individuals who had held an IT job at least once in their entire working history, resulting in 572 employees. After excluding respondents without a high school diploma (n=62), we filtered out those respondents who were not working full time in the IT jobs. This step reduced our sample from 510 to 302 observations. Finally we selected only respondents who have been working for five adjoining years, which resulted in a final sample of 243 respondents.

We employed the approach by Abbott and Hrycak (1990) to assume the work history of each respondent as a job sequence. In this context, a person's career is presented as a series (sequence) of years. Each item in the sequence represents one calendar year. We chose the most prevailing job code for each year by comparing the longest full-time job that year which has a minimum 13 weeks of length in the calendar year (Bureau of Labor Statistics, 2002). Table 2 illustrates a resulting career sequence. The length of the career sequence is 17 years (1998 - 2015). The respondent started with their first full-time job in 1998 in craft, production, and service (O). In 2002, the respondent switched to a technical administration and support job (J). In 2006 the respondent changed the occupation for a job in technical IT and stayed there till the end of the observation.

Cluster	**ID**	**Sequence**															
Year		97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	13	15
IT Career Cluster	112		O	O	O	O	J	J	J	J	I	I	I	I	I	I	I	I

Table 2. Example of a career sequence

3.2 Data Analysis

We divided the analyses according to our studies. First, we examined the patterns of career paths among young IT professionals using optimal matching analysis, as well as cluster analysis. Second, we examined the job characteristics and salaries of the first jobs in the data sample using chi square and ANOVA in R. The used packages were Trajectory Miner (TraMineR) for the optimal matching distance and stats (hclust function) for agglomerative clustering of dissimilarity data.

3.2.1 Career Path Analysis

Following the instructions of Joseph et al. (2012) we chose the sequence analytic approach to identify the career path distance. This analysis consists of two separate analysis techniques: optimal matching analysis and cluster analysis.

We conducted optimal matching analysis by Kruskal (1983) by estimating the similarity of career sequence pairs. This method calculates the resemblance scores of two career sequences with substitution, insertion and deletion from one sequence to another. The most similar pairs are the ones with the least transformation "cost" of a career sequence to another (Abbott and Forrest, 1986). Afterwards, we formed a distance matrix with the cost of the transformation from one sequence to other sequences.

After performing the optimal matching analysis, we conducted a cluster analysis. We chose hierarchical agglomerative clustering using our distance matrix to form the groups of career sequences in the data set. The algorithm forming the basis of this technique is a bottom-up approach that starts with the assignment of each data to the nearest cluster according to its dissimilarity scores. Sequences are then merged together iteratively until a single cluster is formed (Abbott and Forrest, 1986, Jain and Dubes, 1988).

3.2.2 First Jobs Characteristics

To prove our hypotheses for job characteristics, we conducted two types of tests for significance, namely chi square and ANOVA one-way single factor. We used chi square test specially to calculate the significant difference among clusters or job characteristics. Furthermore, we used ANOVA to observe the significant difference between respondents' salaries among clusters, and respondents' back-

grounds. To control for inflation, we considered ´the Consumer Price Index deflator provided by the Bureau of Labor Statistics (2019a). As a base year, we chose the first entry of the first career sequence, which was 1997.

4 Results

In the following we report the results of both parts of the study. We will start with the analysis of young IT professionals' career paths, including a description of the individual career path clusters. In the second subsection we will present the characteristics of young IT professionals' first jobs.

4.1 Career Path Analysis

The results of the cluster analysis indicate a classification of career paths based on three distinguishable clusters. We label the first identified cluster as "IT focused career" which comprises of 102 individuals holding IT jobs for the main part of their careers. We label the second identified cluster as "Non-IT focused career" which contains 111 individuals who went to technical or managerial IT career for a short period of time but did not stay long enough to be allocated to IT focused careers. We label the third cluster as "Managerial focused career" consisting of 30 individuals who held managerial positions in IT or non-IT jobs. The total proportion of each career history is given in Table 3.

Jobs		IT focused career	Non-IT focused career	Managerial focused career	F
IT Jobs					
Technical IT	I	64.54%	19.97%	8.80%	323.08***
Managerial IT	M	0.77%	3.57%	11.59%	18.42***
Non-IT Jobs					
Non-IT Manager	G	2.46%	9.34%	22.53%	27.24***
Non-IT Professional	P	6.08%	17.77%	11.16%	12.4***
Clerical	C	2.77%	16.25%	12.23%	20.34***
Technical Administration & Support	J	2.85%	2.89%	3.65%	0.47
Craft, Production and Service	O	6.15%	11.01%	13.09%	5.57**
Sales	S	3.46%	4.86%	4.08%	0.59
Technicians	T	1%	3.19%	1.93%	2.34
Others					
School/Military/Part-time & Unempl.	X,Y,Z	9.92%	11.16%	10.94%	0.95
Length of Sequence (years)	Mean	12.75	11.86	15.53	28.27***
	SD	2.54	2.43	1.22	
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$					

Table 3. Proportion of each occupation for all clusters

Respondents belonging to the "IT focused career cluster" hold IT jobs for a significant part of their careers (8.32 years; SD = 2.49 years). They tend to bind to technical IT jobs for their whole career or change to non-IT positions by the end of their careers. Individuals belonging to the "Non-IT focused career cluster" hold a variety of jobs for a good amount of time before changing to IT jobs (5.59 years; SD = 4.07 years). After holding IT jobs for a short period of time (2.79 years; SD = 1.38), they tend to go back to their previous occupations or try other occupations. They thus reflect typical short-term visitors in the IT profession. Respondents belonging to the "Managerial focused career cluster" hold IT jobs almost equally (technical: 8.8% and managerial: 11.59%), but only for a short period of time (3.17 years; SD = 2.42 years).

Table 4 presents a closer investigation of each career path. Upon consideration of gender, we found that IT focused careers are dominated by males (84.31 percent; $\chi 2 = 10.29$; $df = 2$; $p < 0.01$). Contrary to the findings of Joseph et al. (2012) the education levels for all careers are balanced compared to our sample proportions ($\chi 2 = 2.92$; $df = 4$). The results also show that the IT focused career path is occupied by individuals who gain formal IT education (64.71 %; $\chi 2 = 30.76$; $df = 2$; $p < 0.001$), mirroring prior research on the correlations between education major and early careers of IT professionals (Ge et al., 2015, Setor and Joseph, 2016).

		Sample	**IT focused career**	**Non-IT focused career**	**Managerial focused career**	**$\chi 2$**
	N	243	102	111	30	
			41.98%	45.68%	12.35%	
Gender	Male	179	86	73	20	10.29**
		73.66%	84.31%	65.77%	66.67%	(*df* = 2)
	Female	64	16	38	10	
		26.34%	15.69%	34.23%	33.33%	
Highest Degree	Postgraduate Degree	36	13	20	3	2.92
		14.81%	12.75%	18.02%	10.00%	(*df* = 4)
	Bachelor's Degree	120	55	51	14	
		49.38%	53.92%	45.95%	46.67%	
	High School (+ some college)	87	34	40	13	
		35.8%	33.33%	36.04%	43.33%	
Major	Non-IT Major	136	36	80	20	30.76***
		55.97%	35.29%	72.07%	66.67%	(*df* = 2)
	IT Major	107	66	31	10	
		44.03%	64.71%	27.93%	33.33%	
* p < 0.05; ** p < 0.01; *** p < 0.001						

Table 4. Individual profiles of career types

Figure 1 provides a comparison of the average salary per career type. Supporting the findings of Joseph et al. (2012), we found that the salary for employees following an IT career is significantly higher ($39,061; SD = $15,200; $F_{2,239} = 4.33$; $p < 0.05$), compared to managerial careers ($36,699; SD = $18,052), and non-IT careers ($32,333; SD = $17,703). However, the 75th percentile of individuals in the managerial career has the highest income ($50,055).

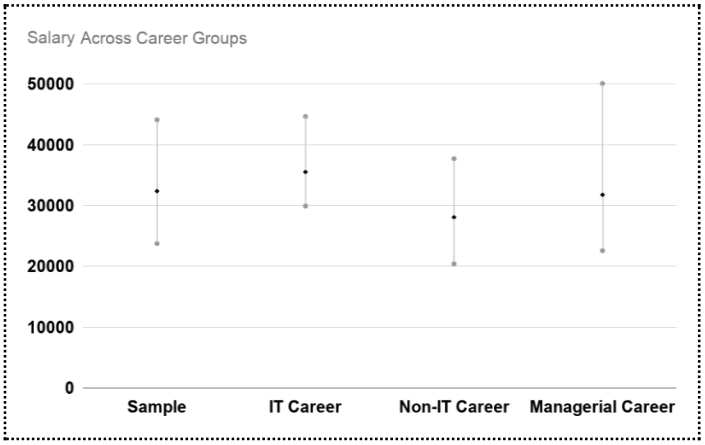

Figure 1. Salary across career types

4.2 First Job Characteristics

4.2.1 Differences between First IT Jobs vs Non-IT Jobs

Table 5 presents first job characteristics, categorized into IT and non-IT jobs. There are 91 respondents (37.45 percent) who chose IT jobs as their first job, 151 respondents (62.14 %) chose a non-IT job. We found significant differences in the highest degrees. The majority of the individuals who choose IT as their first jobs had minimum bachelor's degrees (78%; $\chi 2 = 12.97$; $df = 2$; $p < 0.01$). Thus, H1a (Individuals who choose IT jobs have higher degrees) is supported. Furthermore, there is a significant difference between the choice of first jobs and the career paths taken. 58.8% of the individuals who were classified as following an IT career started with IT jobs after their highest degree ($\chi 2 = 33.86$; $df = 2$; $p < 0.001$). H1b (Individuals who choose IT jobs as first jobs show more persistence in the IT sector) is therefore supported.

		Sample	**IT Jobs**	**Non-IT Jobs**	**χ2**
	N	242	91	151	
			37.60%	62.40%	
Gender	Male	179	69	110	0.26
		73.97%	75.82%	72.85%	(*df* = 1)
	Female	63	22	41	
		26.03%	24.18%	27.15%	
Highest Degree	Master's Degree/ Professional Degree	35	14	21	12.97**
		14.46%	15.38%	13.91%	(*df* = 2)
	Bachelor's Degree	120	57	63	
		49.59%	62.64%	41.72%	
	High School (+ some college)	87	20	67	
		35.95%	21.98%	44.37%	
Career Type	IT Career	102	60	42	33.86***
		42.15%	58.8%	41.2%	(*df* = 2)
	Non-IT Career	110	24	86	
		45.27%	21.82%	78.78%	
	Managerial Career	30	7	23	
		12.35%	23.33%	76.67%	
* p < 0.05; ** p < 0.01; *** p < 0.001					

Table 5. Individual profiles based on IT and non-IT first jobs

4.2.2 Differences Based on Educational Background

Table 6 provides an overview of the job characteristics of first jobs for individuals who attained formal IT and non-IT educational backgrounds. As expected, the majority of IT graduates chose an IT job as their first jobs (52.33%; $\chi 2 = 17.7447$; $p < 0.001$). Thus, H2a (Individuals with IT major background are more likely to choose IT jobs) is supported. There are no significant differences in tech intensity or company size. Therefore, H2b and H2c are not supported. However, more than one third of individuals with IT majors are willing to move outside their cities for their first jobs (34.58 %; $\chi 2 = 5.873$; $df = 1$; $p < 0.05$), compared to only one fifth of individuals without IT major background. Thus, H2d (Individuals with IT major background are more likely to migrate) is supported.

Career Anchor		Sample	IT Major	Non-IT Major	$\chi 2$
	N	243	107	136	
			44 %	56%	
Technical competence: Type of first job	IT Jobs	91	56	35	17.7447***
		37.45%	52.33%	25.73%	(*df* = 1)
	Non-IT Jobs	151	51	100	
		62.14%	47.67%	73.53%	
	Not Available	1	0	1	
		0.41%	0%	0.74%	
Challenge: Tech intensity of first job	High-Tech Intensive Industry	89	41	48	0.1692
		36.63%	38.32%	35.30%	(*df* = 1)
	Non High-Tech Intensive Industry	150	65	85	
		61.73%	60.75%	62.5%	
	Not Available	4	1	3	
		1.64%	0.93%	2.20%	
Independence: Company size	Micro & small companies (<100 empl.)	106	47	59	0.0933
		43.62%	43.93%	43.38%	(*df* = 1)
	Medium & large companies (> 100 empl.)	99	46	53	
		40.74%	42.99%	38.97%	
	Not Available	38	14	24	
		15.64%	13.08%	17.65%	
Stability: Migration for first job year	Move to another city/ state/country	65	37	28	5.873*
		26.75%	34.58%	20.59%	(*df* = 1)
	Staying	163	64	99	
		67.08%	59.81%	72.79%	
	Not Available	15	6	9	
		6.17%	5.61%	6.62%	
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$					

Table 6. First job characteristics based on educational background

4.2.3 Compensation for first jobs

Figure 2 presents respondents' first job salary for IT and non-IT jobs. Overall, respondents with first IT jobs had higher salaries ($25,164 at 25th percentile; $31,403 at median; $41,578 at 75th percentile) than those who had first non-IT jobs ($12,229 at 25th percentile; $23,220 at median; $35,278 at 75th percentile). However, this difference is insignificant, which is why H3a is not supported. Figure 3 displays the average salary across career groups formed in our cluster analysis for individuals who choose IT as their first jobs. On average, respondents who start their first jobs in the IT fields and continue in IT career earn significantly higher ($41,667; SD = $16,538; $F_{1,89} = 5.77$; $p < 0.05$) compared to respondents who change to other career paths later ($33,009; SD = $15,816). Thus, H3b (Individuals who chose IT jobs as their first job and stay in IT careers will have higher salaries) is supported. Table 7 provides an overview of the results of the hypotheses.

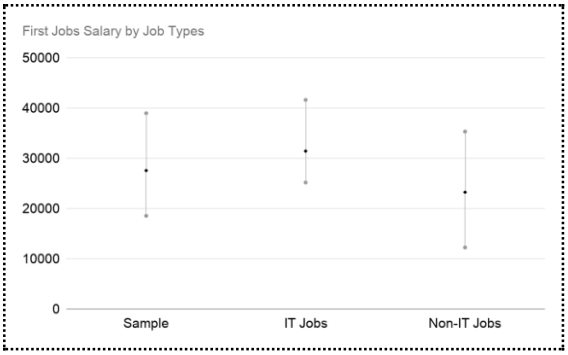

Figure 2. First job salary by job types

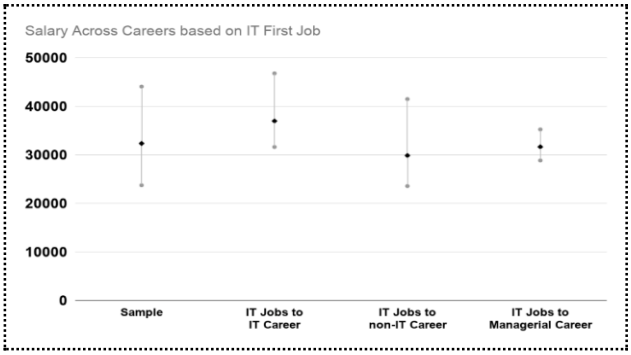

Figure 3: Job salary and career transitions

H1a	Individuals who choose IT jobs as first jobs are more likely to have higher degrees compared to individuals who choose non-IT-jobs as first jobs.	**Supported**
H1b	Individuals who choose IT jobs as first jobs are more likely to show persistence in the IT sector than individuals who choose non-IT-jobs as first jobs.	**Supported**
H2a	Technical competence: Individuals with IT major background are more likely to choose IT jobs as their first job compared to individuals with non-IT major background.	**Supported**
H2b	Challenge: Individuals with IT major background are more likely to choose high-tech industries for their first jobs compared to individuals with non-IT major background.	Not supported
H2c	Independence: Individuals with IT major background are more likely to choose small companies for their first jobs compared to individuals with non-IT major background.	Not supported
H2d	Stability: Individuals with IT major background are more likely to migrate for their first jobs compared to individuals with non-IT major background.	**Supported**
H3a	Individuals who choose IT jobs as their first job have higher salaries compared to individuals who choose non-IT jobs as their first jobs.	Not supported
H3b	Individuals who choose IT jobs as their first job and stay in IT careers will have higher salaries compared to individuals who change their career focus later.	**Supported**

Table 7. Results of hypotheses

5 Discussion

Drawing from prior research on IT career paths and career anchors, we investigated career decisions of young IT professionals. We found a different pattern for IT career paths compared to career paths presented in previous studies, as well as evidence for the boundaryless IT profession. Also, we examined the characteristics of first jobs of IT professionals. We found that IT graduates are attracted by jobs, which support their technological competence and are more likely to change cities for their first job. Furthermore, the results showed that IT professionals who choose their first job in IT show a higher level of persistence in the IT sector. Finally, while individuals who started in IT did not have higher salaries compared to those starting in other sectors, persistence in IT was rewarded financially over the years.

5.1 Contributions and Implications

Our study makes contributions by providing information on (1) contemporary career patterns in IT, (2) the influence of career anchors in early IT career stages, and (3) the compensation of young IT professionals.

First, we contribute to a better understanding of contemporary career patterns in IT by replicating the study of Joseph et al. (2012). Our results are similar but they differ in specific respects. While Joseph et al. (2012) found a balanced picture of three forms of careers (34.6% IT careers, 29.4% PLM careers and 36% SLM careers), our analysis with recent data showed a somewhat different composition. In our data set, we found IT focused careers (42%), non-IT focused careers (46%), as well as managerial

careers (12%). Our results differ from Joseph et al. (2012)'s results in two points: 1) the appearance of a pure management cluster, 2) the unequal distribution of the clusters. We attribute these differences to two factors. First, there is an increasing importance of management skills and thus also the management profession in IT (Goles et al., 2008). This rise in management positions explains why, unlike Joseph et al. (2012), who found a mixed career path between management and professional labor, we identified a clear management career path in our data set. Even though the share of this path is rather small at 12%, we conclude that the IT profession is now opening more towards management positions. Second, we attribute the unequal distribution of the clusters to the young age of the respondents. We expect the share of management careers to rise with the age of respondents, as managerial positions often acquire profound work experience (Shi and Bennett, 2000).

Consistent with previous research on IT careers (Fu and Chen, 2015, Slaughter, 2001), our results support the boundaryless character of the IT profession. Similar to Joseph et al. (2012), we found a significant proportion of boundaryless career forms (non-IT focused careers and managerial focused careers). Individuals in both career types spent a relatively short time in IT and had a clear focus on other positions and occupations. They thus clearly match the boundaryless profile by moving into the IT profession as well as out again. Consequently, we conclude that the younger generation of IT professionals is also assuming an increased form of boundaryless careers. In order to bind young IT professionals to IT in the long term, organizations must involve them at an early stage. Our results show that IT professionals who start their first job in IT are more likely to stay in IT afterwards. We are thus extending previous research by Setor and Joseph (2017), who have demonstrated that career interventions such as internships or mentoring increase persistence in IT careers. Our findings show that IT graduates should be encouraged to pursue an IT career with an early entry into IT jobs, as this increases the chances of a long-term continuation of their IT career.

Particularly noteworthy is the fact that the majority of the 243 professionals working in IT at least once in their career had no IT major background (56%). This finding indicates the decisive influence of workers with non-IT major background on the development of the IT profession. While IT professionals without IT background represent a potential solution to the shortage of IT specialists, this change in IT careers offers numerous new research opportunities. After all, the IT profession is based on a solid social identity (Chang et al., 2012, Dinger et al., 2015). A high number of IT professionals without formal IT training can trigger a shift in the social identity of the IT profession and thus change the IT profession itself in a sustainable way. This change should be addressed in future research.

Second, we contribute to the research on career anchors of young IT professionals (Arnold et al., 2017, Chang et al., 2012). We investigated the influence of career anchors on the choice of the first job of young professionals with IT major backgrounds: technical competence, challenge, independence and stability. Contrary to our expectations, only two of the four hypotheses about career anchors could be supported: high desire for technical competence and low desire for stability. IT graduates filled significantly more jobs that help evolve technological competence, which supports that IT graduates are already committed to the career anchor technical competence in their early years. We hereby confirm past literature that has demonstrated the importance of technical competence for IT professionals (see for example Crepeau et al. (1992) and Igbaria et al. (1991)) and illustrate that despite the changing nature of the IT profession, technical competence is still a decisive criterion for IT graduates.

Whereas we could not find evidence for the attractiveness of high-tech industries and small companies for young IT professionals, IT graduates were more willing to move for their first jobs. Thus, we confirm Chang et al. (2011)'s findings that geographical security is less important for IT professionals in their early years. However, we found no evidence for Arnold et al. (2017)'s and Taylor and Joshi (2019)'s studies that introduced challenge and independence as influence factors for career decisions of IT professionals.

We provide two explanations for the discrepancies between our findings and existing research. First, the results may be related to the young age of our sample. Graduates usually have fewer obligations compared to employees at later stages in their careers. Increases in responsibility resulting from private and professional contexts (family or leadership positions) lead to changing career anchors (Chang

et al., 2011). Young IT professionals may be less influenced by career anchors due to their flexibility compared to older employees whose career decisions are highly dependent on their responsibilities. Second, there may be a difference between intention and action. Similar to turnover research, which reports that turnover intention only predicts 30% of actual turnover cases (Maier et al., 2015), young IT professionals may intend to make career decisions based on career anchors, but deviate from them in terms of their actual decision because of external influences like the current economic climate.

Third, our research contributes to insights into the salaries of young IT professionals. Even though the data showed higher average salaries for first IT jobs, we could not find a significant difference from the salaries of non-IT jobs and therefore cannot confirm the study of Ge et al. (2015). However, the data indicated that persistence in the IT career pays off. The findings demonstrated that IT professionals who take their first job in IT and then remain in IT careers earn significantly more than those who subsequently migrate to other career paths. We thus confirm literature on IT Professionals' salaries that had proved that IT careers are financially profitable (see for example Slaughter et al. (2007) and Joseph et al. (2012)) and expand it with the insight that a later change into other career types could be financially disadvantageous for IT professionals.

For organizations, our study provides valuable insights into the career decisions of young IT professionals. First, our analysis of career paths reveals a high diversity of IT professionals. Especially the high percentage of individuals without IT major background is remarkable. This underlines the willingness of career changers to enter IT. Tech companies could therefore make increasing use of career changers to address the shortage of IT specialists. Second, it is important to get IT professionals into IT as soon as possible, as early starters in IT show a higher persistence in IT careers. Companies should therefore start to interact with potential employees at an early stage, to bind them to IT profession for the long-term. Ultimately, while IT graduates look for jobs with IT focus, we could not prove a preference for jobs in the high-tech intensive industry. This calls on high-tech companies for improved recruitment techniques for young IT professionals by advertising work at the cutting edge of technology.

5.2 Limitations and Future Research

We acknowledge that this study has several limitations. First, we limited our study to US based data. Thus, the results are specific to the US context. However, following previous work with the NSLY (see for example Joseph et al. (2012) or Setor and Joseph (2017)) we believe that our results reflect a general trend of IT careers. For future research, we recommend to replicate the studies with other datasets and test the results in different geographical and cultural contexts. Second, our study deals with observations based on a secondary data set. However, career anchors are individuals' self-perceptions, and thus also include subjective opinions and feelings (Schein, 1996). In addition, career decisions of IT professionals are influenced by a variety of factors (Ghapanchi and Aurum, 2011). Future research should therefore investigate to which young IT professionals are able to follow their career anchors, and whether intention and subsequent decisions of young IT professionals differ from each other.

6 Conclusion

With the transformation of the IT profession, research into career decisions of young IT professionals is becoming increasingly important. Our study provides insights into (1) contemporary career patterns in IT, (2) the influence of career anchors in early IT career stages, and (3) the compensation of young IT professionals. We found evidence for the boundaryless IT profession and prove that persistence in IT careers is related to the choice of the first job. Also, our analysis shows that IT graduates are attracted by jobs, which support their technological competence and are more likely to change cities for their first job. Finally, while individuals who started in IT did not have higher salaries compared to those starting in other sectors, persistence in IT is usually rewarded financially over the years. Our study helps to better understand the career decisions of young IT professionals.

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The Things That Drive Us – How the Next Generation of IT Professionals Defines Contemporary Career Success

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Abstract. Modern career concepts revolutionize our understanding of a successful career. Employees nowadays define career success in many diverse ways, based on a variety of personal goals. To attract the next generation of IT professionals and to improve gender balance in IT, organizations must understand future IT professionals' perceptions of a successful career. By analyzing 127 personal career success definitions from IT students in Germany, we present a broad spectrum of desired career success factors in IT. We illustrate the concept of career success dualism, which describes career success as a balance between multiple factors, such as remuneration and work-life balance. Furthermore, we present how female IT students have a stronger drive toward subjective career success factors than males. Our study contributes to a better understanding of current IT students and suggests how organizations can hire and retain the next generation of IT professionals.

Keywords: IT students, careers, career success dualism, objective career success, subjective career success

1 Introduction

The high demand for information technology (IT) professionals is an issue faced by many companies worldwide. If companies are unable to compete in the highly competitive market for IT professionals, they face major competitive disadvantages and even financial losses [1]. Companies will need to attract the next-generation IT professionals, apart from experienced IT professionals, as they bring with them up-to-date and highly demanded IT knowledge [2, 3]. To attract young IT talent and maintain diversity in IT, organizations must understand and meet the career goals and needs of the next generation of IT professionals [1]. Thus, investigating contemporary definitions of career success (CS) of male and female IT students is promising.

Current trends in the IT job market require redefining and re-evaluating CS in IT. First, IT professionals are increasingly pursuing modern career paths [4]. In the past, employees commonly moved vertically within a company based on promotion [5]. However, modern career paths in IT also allow horizontal movements between organizations and even occupations [6]. These modern careers correspond to a more contemporary mindset, especially shared by young individuals who strive for diverse work experiences rather than hierarchical advancement [7, 8]. Second, in the past many

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employees sought advancement in salary and position within one company to secure their own and their family's living. However, nowadays the importance of one life-long employer decreases [9]. Consequently, future IT professionals are more open to organizational turnover [2], which makes it even harder for companies to compete in the war for IT talents.

With an increase in contemporary career paths in IT and a changing mindset regarding the importance of a career, addressing how these changes affect our definition of CS is necessary. Considering the crucial influence of organizational practices on the fulfillment of CS [10], understanding contemporary definitions of CS in IT is important for individuals and companies [11, 12]. Based on the literature on the scarcity of women in IT [3, 4], women must be better integrated into the IT profession, and attractive jobs and development opportunities in IT must be created. Thus, we explore the following research questions:

RQ1: How do current IT students define career success?

RQ2: Do IT students' definitions of career success vary across gender?

We investigate these research questions using a mixed method approach. We asked IT students at three German universities about their definitions of CS. Our study contributes to a better understanding of the contemporary definitions of CS in IT and helps organizations to better engage with the needs of the next generation of IT professionals.

2 Theoretical Background

To understand contemporary definitions of CS in IT, we must first review the literature on CS, as well as on the gender imbalance in the IT profession. Thus, we present the related studies on these topics in this section.

2.1 Career Success

CS is defined as the "accomplishment of desirable work-related outcomes at any point in a person's work experiences over time [5]". It is traditionally divided into objective and subjective factors, often reflecting an organizational and individual perspective [6-8]. While organizational actors, from an external perspective, often assess an individual's CS based on measurable factors, such as remuneration and advancement [9], an individual's perception and definition can take on many different facets [5, 10]. Subjective CS therefore reflects personal goals and also takes into account non-measurable goals, such as the desire for meaningfulness or a sense of security [11].

Modern career paths have a lasting impact on our understanding of CS and consequently also on the choice of our employers [11, 12]. The increased diversity in careers makes it more difficult to compare career paths and success [13]. Corporate advancement, in particular, is difficult to measure as the diversity of contemporary careers means that career mobility is no longer just vertical, but also increasingly horizontal [14]. Studies even illustrate how employees, called "happy-losers", are willing to move to new jobs with better chances for subjective CS, even though this

might have a negative impact on their objective CS [15]. Personal career definitions are therefore becoming increasingly important [12], making it essential for companies to regularly assess the career plans of their employees. Given the importance of contemporary CS, it is promising to investigate IT students' definition of CS.

2.2 Career Success in the IT Profession

Traditional, objective career success factors (CSFs) such as remuneration and promotion are well explored in IT workforce research [16-19]. Due to the high demand for IT professionals, they are usually in a good position to negotiate good salaries and are therefore among the best-paid professions in Germany [20]. However, advancement often meant a shift away from IT to higher management positions [10]. To address the technical affinity of technical specialists and offer advancement for IT professionals without desire for personnel responsibility, companies are increasingly offering dual career paths that give IT professionals the chance to choose between advancing to a management or a specialist career [21].

However, more recent studies have shown that the IT profession has moved on from dual career path models [22]. A more diverse image of the IT profession is now emerging, allowing for modern careers in IT that switch between organizations and even occupations [22]. The decreasing significance of vertical advancement is likely to change the meaning of objective CS such as remuneration and advancement [11, 12]. Consequently, CS in IT is now increasingly defined in terms of subjective CSFs by IT professionals [23].

2.3 Gender Imbalance in the IT Profession

The inclusion and retention of women in IT is an ongoing challenge [24], thus research has been studying women and their careers in IT for years [3, 4, 25]. Women in IT often encounter societal, organizational, and personal obstacles that prevent women from entering and advancing in IT field [26-28]. Literature indicates that men are twice as likely to be hired over an equally qualified woman for STEM positions [29], Further, after accessing IT positions, women in IT may face barriers and unconscious bias [30]. These factors include social expectations [3, 31], work-family conflict [27, 32], men-oriented IT occupational culture with a lack of role models and informal networks in the organizations [3]. As a consequence, women repeatedly choose to leave IT, further exacerbating the gender imbalance in IT [3]. In order to keep women in IT in the long term, organizations must therefore pay more attention to their needs and career plans. Since CS and work outcomes are evaluated differently by women and men [33-35], we aim to investigate whether the definition of CS differs between female and male IT students and how organizations can improve gender balance in IT by promoting gender-specific career plans.

3 Research Method

To explore the contemporary perception of CS in IT, we asked IT students for their personal definition of CS. This section explains the research design, data collection, and data analysis.

3.1. Research Design

For our study, we captured definitions of CS among IT students using an online survey. Due to the lack of qualitative research on CS in IT and in order to capture the relative importance of different CSFs, we deemed a qualitative approach appropriate. Thus, we oriented ourselves on other research on CS investigating CS definitions in a qualitative way [23, 35] and opted for the following open-ended question: *Career success means something different for everyone. For some it means a high salary and personnel responsibility, whereas for others it may mean a good work–life balance. Please explain in your own words what career success means to you. Career success means to me…."* In addition, the survey included questions regarding field of study, the current semester, and personal data such as age and gender. Based on these questions, we coded the different definitions of CS and identified differences across gender.

3.2. Data Collection

We defined current IT students as our target group. Since IT is a highly diverse professional field, we decided to include students who were currently pursuing a degree in IT or a similar field. This restriction included the following studies: Computer Science/Informatics, Information Systems, Games Engineering, Data Engineering, Robotics and Media Informatics. At the beginning of December 2020, we started a call for participation in the study at three German universities, offering the mentioned study programs, with which we reached about 700 IT students. By the end of December, we had received 127 complete definitions of CS by our target group (response rate: 18.1 %). The descriptive analysis of the sample shows that 31.5 % of the sample was female. The majority of the students pursued a bachelor's program (84.3%) and were in their third or higher year (81.1%). Table 1 provides an overview of the students' demographics.

3.3. Data Analysis

To gain the best possible insights from the large number of career definitions, we decided to examine the data using a mixed method approach [36]. As a first step, we pursued a qualitative approach that involved coding the responses and identifying different CSFs. Second, we ranked the mentioned CSFs based on their importance and examined differences in the definitions based on gender, using a quantitative approach.

Table 1: Sample Characteristics

Characteristic	Category	n=127	%
Gender	Female	40	31.5%
	Male	87	68.5%
Age	18 – 20 years old	31	24.4%
	21 – 23 years old	73	57.5%
	24 – 26 years old	17	13.4%
	27 or higher	6	4.7%
Degree	Bachelor	107	84.3%
	Master or Higher	20	15.7%
Study Period	First Year	6	4.7%
	Second Year	18	14.2%
	Third Year	64	50.4%
	> Three Years	39	30.7%

For the coding steps, we were guided by established studies on CS and oriented ourselves on their categorization of CS [11, 23]. We conducted the coding in three steps, covering both inductive and deductive coding. In the first step, we followed an axial coding approach and divided the definitions into several subcategories [37]. For example, we assigned two subcategories to the following statement: "*[To me, CS means] to have a leading position in my field and at the same time to connect it with a beautiful work-life balance."* The subcategories we assigned were leadership and work-life balance. In the second step we conducted selective coding and merged the subcategories to main categories [37]. For example, the above-mentioned subcategory leadership was assigned to the main category "advancement", while the subcategory work-life balance was assigned to the main category "compatibility with private life". In this step, we followed the coding scheme of Gubler [23] to make the results comparable to previous, rare qualitative research on CS of IT workforce. To be precise, we tried assigning our identified subcategories to main categories also found by Gubler [23]. If we could not assign a subcategory to a main category suggested by Gubler [23], we defined a new category. This step resulted in ten main categories of CS (see 4 Results). Finally, we classified the main categories based on objective and subjective CSFs, resulting in two objective CSF categories and eight subjective CSF categories. All three coding steps were conducted by two researchers. The comparison of the codes at the end of the coding process resulted in a coder reliability of 90%.

To get deeper insights into the data set, we decided to follow up with a quantitative approach. First, to understand the importance of the different CSFs, we ranked them according to the number of times they were mentioned in the data set. Finally, we calculated the differences in the statements based on gender with a chi-squared test.

4 Results

4.1 Career Success Definitions by German IT Students

Table 2 presents an overview of the identified objective and subjective CSFs and provides the definition and an example from the data set. For objective CSFs, we found statements that covered definitions on (1) *remuneration* and (2) *advancement*. These definitions included traditional interpretations of CS based on monetary compensation or on rises of positions. For example, a male Games Engineering student stated that CS means to have "e*nough money to afford a good life with my family",* hence defined CS based on remuneration. A female Information Systems student defined CS as *"the rise to leadership",* and thus followed traditional CS definitions based on advancement.

Table 2: Career Success Definitions of the Next Generation of IT Professionals; for a comparison see Gubler [23]

Categories of Career Success		Definition	Example Quotes – Career success means to me…
Objective Career Success Factors			
1	Remuneration	CS defined in terms of monetary compensation.	*Enough money to afford a good life with my family.*
2	Advancement	CS defined in terms of rises of positions.	*Rise to leadership.*
Subjective Career Success Factors			
3	Compatibility with private life	CS defined in terms of being able to pursue a fulfilling private life.	*A work–life balance, whereby work can be in the foreground over certain periods, but in other times, it does not take everything.*
4	Satisfaction	CS defined in terms of positive feelings about the job or the life.	*When work no longer feels like work.*
5	Meaningful work	CS defined in terms of valuable work.	*Changing the world for the better.*
6	Self-development	CS defined in terms of self-realization.	*Finding a position where I can develop and increase my skills.*
7	Challenging and interesting work	CS defined in terms of challenging, and interesting work.	*Working on interesting problems and becoming a world-class expert in my field.*
8	Independence	CS defined in terms of being able to make decisions independently.	*The ability to decide for yourself what to work on.*
9	Recognition	CS defined in terms of being recognized at work.	*When the other employees like me and like to work with me.*
10	Job security	CS defined in terms of having a secure job.	*Stable employment relationship.*

Subjective CSFs, on the other hand, were more diverse. In total, we found eight subjective CSFs, including (3) *compatibility with private life*, (4) *satisfaction*, (6) *self-development* and (8) *independence*. In addition, we also found definitions on a task level, which described the type of work: (5) *meaningful* or (7) *interesting and challenging work*. For example, a male Computer Science student defined CS as pursuing *"work that enables me to change the world for the better"*. We also found statements that included references to (9) *recognition*, meaning that students defined CS based on a general definition of being recognized or respected. For example, a female Computer Science student defined CS based on the relation with her work colleagues: "*[To me, CS means] when the other employees like me and like to work with me."* Finally, few students indicated that CS for them meant (10) *job security*.

To understand which CSFs hold particular importance for the next generation of IT professionals, we ranked the identified CSFs based on the counts of their mentions (see Table 3). As one statement of a single student could include several CSFs (for example remuneration and work-life balance), we were able to identify 217 CSFs based on the 127 statements, meaning one single definition included 1.7 CSFs on average. To explain this in more detail, Table 3 provides an overview of the dimensions of the CS definitions. 52 participants (40.9%) defined CS based on one dimension only. Out of these 52 participants, 15 defined CS based on one objective CSF only, and 37 participants defined CS on one subjective CSF only. More than half of the participants (n= 75; 59.1%) defined CS not one-dimensionally, but based on two or more CSFs.

Table 4 provides information on the ranking of the identified CSFs (Column Total). Out of the 217 identified CSFs, 72 (33.2%) were objective CSFs, and 145 (66.8%) were subjective CSFs. The most frequently mentioned CSF was remuneration. We found 48 statements (22.1%) that referred to monetary aspects defining CS. We noticed a great variety of statements in this category. Few statements on salary included a definition that involved striving for a high amount of money. However, most of the identified definitions included statements about being satisfied with the salary or having a secure income. The following definition of a male Computer Science student summarizes this finding: "*CS for me is when I can pursue the projects that I enjoy without paying attention to whether they will bring me enough money or not."* We conclude that remuneration as a CSF does not automatically mean striving for more money. It can also mean striving for 'enough' money.

Table 3: Career Success Definitions One-Dimensionally vs Multi-Dimensionally

	One-dimensional Definitions n=52 (40.9%)		**Multi-dimensional Definitions n=75 (59.1%)**		
Whole Sample n=127	**Objective** n=15 (11.8%)	**Subjective** n=37 (29.1%)	**Objective only** n=7 (5.5%)	**Subjective only** n = 26 (20.5%)	**Subject. + Object.** n=42 (33.1%)
Male	15	25	4	13	30
Female	0	12	3	13	12

Table 4: Identified Career Success Factors in Total and Based on Gender

Categories of CSFs	Total $\sum_t$=217	Male $\sum_m$ =140	Female $\sum_f$=77	Difference in %
Objective CSFs	**n=72 (33.2%)**	**n=53 (37.8%)**	**n=19 (24.7%)**	**-13.1%**
1 Remuneration	**48** (22.1%)	**35** (25.0%)	**13** (16.9%)	-8.1%
2 Advancement	**24** (11.1%)	**18** (12.9%)	**6** (7.8%)	-5.9%
Subjective CSFs	**n=145 (66.8%)**	**n=87 (62.1%)**	**n=58 (75.3%)**	**+13.2%**
3 Compatibility with private life	**32** (14.8%)	**18** (12.9%)	**14** (18.2%)	+5.3%
4 Satisfaction	**31** (14.3%)	**16** (11.4%)	**15** (19.5%)	+8.1%
5 Meaningful work	**20** (9.2%)	**14** (10.0%)	**6** (7.8%)	-2.2%
6 Self-Development	**17** (7.8%)	**10** (7.1%)	**7** (9.1%)	+2.0%
7 Challenging & interesting work	**15** (6.9%)	**8** (5.7%)	**7** (9.1%)	+3.4%
8 Independence	**13** (6%)	**12** (8.6%)	**1** (1.3%)	-7.3%
9 Recognition	**13** (6%)	**6** (4.3%)	**7** (9.1%)	+4.8%
10 Job security	**4** (1.8%)	**3** (2.5%)	**1** (1.3%)	-1.2%

24 statements (11.1%) referred to advancement in the organization, for example in terms of gaining responsibility. A male Information Systems student defined this type of CSF as: "[*To me, CS means] achieving a senior position that allows me to manage a big team and make critical decisions."*

The most mentioned subjective CSFs were compatibility with private life (n=32, 14.8%) and satisfaction (n=31, 14.3%). Students who defined CS based on these terms stated that they want to be able to find time for their families and hobbies. Furthermore, we found statements indicating the wish to not work fulltime. The following statement of a male Computer Science student illustrates this finding: "*To me, CS is finding a job that makes me happy and which requires me to not work fulltime."*

Finally, 20 statements (9.2%) pointed to CS based on meaningful work, meaning that these students were searching for work that significantly contributed value to their organization or to society. The rest of the CSFs were self-development (n=17, 7.8%), challenging and interesting work (n=15, 6.9%), independence (n=13, 6.0%), recognition (n=13, 6.0%), and job security (n=4, 1.8%).

4.2 Career Success Factors Based on Gender

Finally, we were interested in whether we could see differences in the definitions of CS based on gender. The columns Male vs Female in Table 4 illustrate the gender distribution and their career definitions. A total of 140 CSFs were assigned to men and 77 to women, corresponding to a normal distribution in IT workforce samples [38].

Based on the results, we suggest that subjective CSFs are considerably more important for women than for men. Only 19 (24.7%) statements of female IT students pointed to CS based on remuneration or advancement. Rather, women seem to attach greater importance to subjective CSF (n=58, 75.3%) especially to satisfaction (19.5%), and compatibility with private life (18.2%)

Two further remarkable aspects are the unequal distributions of the CSFs independence and recognition. We found fewer statements of women indicating defining CS based on independence (m= 8.6% vs. f= 1.3%). However, women defined CS based on recognition more often (m= 4.3% vs f= 9.1%). These results indicate a lower wish to work independently but a higher desire for recognition by women in IT.

We performed a chi-squared test of independence to examine the gender differences in the analysis. We found a significant difference between the two samples in terms of objective versus subjective CSFs ($X^2(1, n=217) = 3.9$, $p=.048$).

5. Discussion

In the following, we elaborate on our key findings, provide theoretical and practical implications and explain limitations and future research of this study.

5.1. Key Insights

- **Perceived Career Success by the Next Generation of IT Professionals**

In total, we found ten types of CSFs based on 127 definitions on CS. Interestingly, most of the CSFs (66.8%) were not linked to objective CSFs, but rather to subjective CSFs. This result indicates that, following recent literature on contemporary CS [12, 23], the next generation of IT professionals in Germany will increasingly look for meaningful and satisfying jobs which offer compatibility with their private lives.

At the same time, however, we wish to urge that the importance of objective CSFs should not be underestimated. Although it appears that most of the CSFs were subjectively associated, remuneration and advancement were frequently paired with subjective CSFs and remained among the most frequent mentioned CSFs. We suggest that remuneration and advancement function as hygiene factors. Similar to Gubler [23], we found statements on remuneration that underline the importance of *enough* money, without highlighting a *high amount* of money. Due to the ongoing IT skill shortage and the good payment in IT, the next generation of IT professionals might view monetary compensation as a foundation for success in their careers. Since the absence of hygiene factors can lead to great dissatisfaction among IT professionals [39], we advise researchers and companies to consider remuneration as a main CSF in IT.

- **Career Success Dualism**

As indicated above, more than half of the IT students provided definitions of CS that included not only one CSF, but two or more. In these multi-dimensional statements, we often found that CS was defined as a balance between different, sometimes even competing CSFs, a phenomenon that we would like to describe as *career success dualism.* Many of the statements indicated the importance for students to generate a good income during their career or rise in positions within the company, while realizing their own potential (self-development), doing challenging work (challenge), or being happy (satisfaction). Some examples for CS dualism, we found in our data set:

Challenge & remuneration: *"[To me, CS means] constantly being challenged with varied tasks* ***while*** *getting a salary from which I can live without any problems*."

Advancement & compatibility with private life: *"[To me, CS means…] to have a leading position in my field and* ***at the same time*** *to live a beautiful work-life balance."*

Meaningful work & remuneration: *"[To me, CS means…] to do something that positively affects the world,* ***but also*** *earning enough to have family."*

Additionally, we found that IT students with wish for CS dualism do not necessarily want the extremes of both CSFs, but rather wish to bring different CSFs into balance (e.g., money & work-life balance). To address CS dualism among young IT professionals, companies must satisfy a broad range of CSFs, ideally in combination with each other. Identifying promising combinations of CSFs and implementing adequate actions are an interesting starting point for new corporate IT recruitment and retention efforts, as they show that companies can work with their employees to explore a balance of CSFs that is beneficial to both the employer and the employee.

- **Perceived Career Success and Gender**

The results support previous research on CS of women in IT [23] and showed that women named subjective CSFs significantly more often than men did. In line with Armstrong's [3] findings, we suggest that women's career plans may be influenced by social and structural factors, therefore influencing their success definitions, which organizations need to consider when shaping career opportunities for women in IT. To maintain gender diversity in IT, we recommend the following measures.

(1) *Recognition of women in IT.* IT workforce research points out societal, organizational, and personal obstacles that prevent women from advancing in IT [26-28]. Highlighting the desire for *recognition* by women in IT, we suggest that organizations will need to provide more room for development for women in the male dominant IT environment. Specifically, organizations should celebrate women in IT leadership roles to create role models for future female IT professionals. Furthermore, organizations should organize networking events and mentoring programs to overcome bias and increase recognition, as well as visibility of women in IT. Given the frequent mention of the CSF *satisfaction* in the women's sample, companies should adopt an inclusive organizational culture that clearly promotes diversity in IT and makes the IT environment a friendly environment for a diverse group of professionals.

(2) *IT career paths that meet diverse needs.* Women's career plans might differ from men's as their career planning has to combine social expectations and professional success [30, 32]. To retain women in IT, we suggest that organizations should leverage the boundaryless structure of IT [40] and ensure flexibility in organizational and

occupational paths, so that women can craft positions and work arrangements based on their needs. By ranking *compatibility with private life*, *satisfaction* and *remuneration* as the three most mentioned CSFs, female IT students made a clear statement that they want to fulfill subjective CSF without having to forego salary. Diverse options for different career paths in IT will allow women to design their own IT career path according to their own desires and will reduce dropout rates in IT. By giving opportunities for crafting the profession to their needs, companies will not only tackle the gender imbalance in IT but also improve their processes and performance [41].

5.2. Theoretical Implications

Our study has theoretical contributions in the following areas:

(1) *Contemporary career design and its consequences in IT*. The present study illustrates modern definitions of CS of the next-generation IT professionals. Thus, we contribute to a better understanding of the future development of careers in IT and consequently add our findings to the research on careers in IT [22, 38]. The study results suggest that careers in IT will continue to become more diverse as the next generation of IT professionals highly values subjective CSFs, supporting the research of [23]. With insights on CS dualism, we furthermore extend the research on CS in IT by [23] and provide recommendations for contemporary career design in IT. We expect that IT professionals will consequently increasingly take charge of their own career planning in IT and follow their own goals and values. Accordingly, the IT profession might keep evolving into a boundaryless profession [22] - implying that we can expect more career mobility between organizations and even professions in the future.

(2) Gender imbalance in the IT profession. With this study, we want to contribute to a better understanding of the next generation of women in IT and accordingly provide new perspectives on how to tackle gender imbalance in IT. Our study shows gender-specific differences regarding CS in IT. Through our two suggestions *(Recognition of women in IT* and *IT career paths that meet diverse needs*), we extend the literature recommendations on the inclusion of women in IT [3, 30, 32]. By discovering that subjective CSFs play a more important role for women than for men, we provide new suggestions for explaining why women in IT follow different career paths [3]. The multitude of subjective CSFs of female IT students indicates that they might not strive for typical vertical career ascents in companies, and rather follow their own subjective career values and goals. With this study, we hope to continue to draw attention to women in IT and call on organizations to give more space to women in IT.

5.3. Practical Implications

With this paper, we provide insights into future IT professionals' plans for their careers. We would like to point out several ways for companies to hire and retain young IT professionals. First, to compete in the IT job market, companies must satisfy a broad range of CSFs, ideally in combination with each other. Organizations need to understand that the career plans of the next generation of IT professionals often include a combination of multiple CSFs, for which the employees might be willing to

compromise. By addressing several CSFs at the same time, organizations can offer development opportunities that are beneficial to both the employer and the employee. Second, the study results illustrate how remuneration still functions as an important factor for young IT professionals. Therefore, companies should pay attention to fair pay and supplement monetary recognition with other forms of appreciation, such as challenging and exciting projects or freedom to make decisions. Finally, a greater number of subjective CSFs could lead to a shift away from vertical advancement in IT towards a more diverse range of development. Therefore, companies should offer contemporary career paths to retain IT professionals and improve gender balance in IT.

5.4. Limitations and Future Research

The limitations of our study stem firstly from the research design. We focused on IT students in Germany; hence, our study may be influenced by the cultural and geographical context. The prevailing conditions could shape perceived CS in the country. Therefore, for the generalizability of the results, we hope to replicate the study in an international context. Finally, we assume that the perception of CS, similar to career anchors [42], might change over the course of a career. This would imply that the surveyed IT students might be targeting different CSFs over time. Therefore, we suggest that companies continuously evaluate their employees' perceived CS and adjust their employees' development plan accordingly.

In addition to replicating this study in the international context, we would be happy to read more studies on careers in IT that specifically address the perceptions of individuals working in IT. By only investigating career paths, we tend to conduct career research from an abstract level without talking with the people behind the careers. We therefore call for more qualitative studies on CS of IT professionals.

Furthermore, our study provides a better understanding of the next generation of IT professionals. To understand modern career values, researchers should investigate IT students and their career plans. As presented by studies on career interventions, persistence in IT is already shaped in college years [43]. This makes it even more important to study the aspirations and plans of prospective IT professionals. Therefore, we call for more research to better understand the next generation of IT professionals.

6. Conclusion

This study was motivated by the need for organizations to understand the career plans of the next generation of IT professionals to compete in the war for talents. We asked current IT students for their definition of CS and found the phenomenon of career success dualism, describing CS as a balance between multiple CSFs. Furthermore, we show that women define CS differently than men, with a focus on subjective CSFs. Therefore, companies should create career opportunities and settings in line with the preferences of women in IT. Our study contributes to a better understanding of the next generation of IT professionals and provides recommendations for hiring and retaining IT talent.

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LEAKS IN THE IT WORKFORCE PIPELINE: INVESTIGATING IT STUDENTS AND THEIR PLANS TO LEAVE OR STAY IN THE IT PROFESSION

Research Paper

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Abstract

To remain competitive in the fast-paced information technology (IT) industry, companies will have to rely heavily on the next generation of IT professionals. Yet we know little about future IT professionals' career plans: Are contemporary career attitudes tempting IT students to leave the IT profession? And can early professional identification prevent potential exit plans? Based on a survey with 180 IT students, we investigate how their turnaway intention from IT is shaped by their boundaryless career attitudes (BCAs), namely the desire for interdisciplinary work and the desire for inter-organizational mobility, and how professional identification influences this relationship. We find divergent effects of the two BCA forms on turnaway intention. In addition, we find a reducing effect of professional identification on turnaway intention, but also surprising interaction effects with BCAs. Our findings indicate that IT students with different BCAs follow distinct career paths across organizations and professions. Our study contributes to research on IT careers and provides guidance for organizations on how to employ future, boundaryless IT professionals.

Keywords: career; boundaryless; turnaway; professional identification; interdisciplinary work

1 Introduction

The war for talents in the Information Technology (IT) sector has been ranked among the most worrisome concerns of IT executives (Kappelman et al., 2017). To drive future technological progress, many companies will have to rely heavily on the next generation of IT professionals. Nonetheless, the job market frequently loses IT professionals through attrition after graduation or during early career stages (Setor and Joseph, 2021). This leak in the IT workforce pipeline exacerbates the ongoing IT skills shortage, making IT graduates' persistence in the profession both a key research issue and a key practical issue. Therefore, understanding IT graduates' career decision-making (Walker and Tracey, 2012) is significant in the IT profession's sustainability, consequently requiring better understanding of future IT professionals' career attitudes.

One phenomenon that will be crucial to research on future IT professionals is the impact of boundaryless career attitudes (BCAs) on IT careers (Gubler et al., 2014, Guan et al., 2019). Professionals with boundaryless careers are largely driven by two BCA forms: (1) the desire for interdisciplinary work and new experiences (IDW) and (2) for inter-organizational mobility (IOM) (Briscoe et al., 2006). Boundaryless careers thus correspond to the contemporary mindset shared especially by young individuals who strive for diverse work experiences rather than hierarchical advancement (Guan et al., 2019). As a result, professionals with BCAs frequently design their careers independently of their current organization or profession (Tams and Arthur, 2010, Arthur, 1994).

Predicting BCAs' influence on future IT professionals' career decision-making is difficult. Studies investigating contemporary IT careers have shown that boundaryless IT professionals exhibit increased inter-organizational and inter-professional mobility (Ituma and Simpson, 2009, Joseph et al., 2012). Due to IT's strong integration into various contexts in companies (Rutner et al., 2011, Niederman et al., 2016) and ease of transferring IT skills between organizations and even professions (Ferratt et al., 2005, Ang and Slaughter, 2004, Joseph et al., 2012), we expect the next generation of IT professionals to develop stronger preferences for IDW and IOM. Consequently, increased BCAs might lead IT students to explore professions outside IT, thus increasing the risk of leaving the IT profession (i.e., turnaway from IT). In contrast, the strong occupational culture in IT indicates high professional identification (PI) (Guzman et al., 2008, Riemenschneider and Armstrong, 2021), which decreases the intention to leave IT (Brooks et al., 2015). Thus, PI might be a powerful starting point for lowering turnaway risk due to contemporary career attitudes and for retaining young IT professionals. Therefore, investigating interactions between BCAs and PI and their influence on the next generation's career decisions is promising.

We dedicate this study to generating improved understanding of future IT career development by investigating IT students' levels of BCAs and PI. Specifically, we want to determine the extent of BCAs' influence on plans to leave or stay in the IT profession. Furthermore, we investigate how PI shapes BCAs' influence on the intention to leave the IT profession through the following research questions:

- *How do different forms of boundaryless career attitudes affect IT students' intentions to leave the IT profession?*
- *How does early professional identification influence the relationship of boundaryless career attitudes and turnaway intention of IT students?*

To answer these questions, we surveyed 180 IT students. We found contrasting impact of the two BCA forms on turnaway intention. Based on the analysis' results, we derived examples of IT students with BCAs and now provide recommendations for organizations on how best to employ them. Our study is expected to provide theoretical implications for research on future IT careers and to present organizations with guidance on empowering the next generation of IT professionals.

2 Theoretical Background

In the following, we define this paper's underlying concepts and present existing research. We introduce BCAs and their consequences and provide research on PI and turnaway in the IT context.

2.1 Boundaryless Career Attitudes

Boundaryless careers are defined as the opposite of organizational "bounded" careers (Arthur, 1994), that is, career paths of "sequences of job opportunities that go beyond the boundaries of single employment settings" (DeFillippi and Arthur, 1994). Instead of aspiring to a career within a single organization, individuals with boundaryless careers pursue job opportunities outside their organizations and even outside their profession (Arthur, 1994, Tams and Arthur, 2010). As a consequence, the responsibility of career planning in boundaryless careers is passed on to the individual (Arthur, 1994, Guan et al., 2019), while organizations are increasingly given the role of observers and supporters.

Boundaryless professionals are largely driven by two career attitudes (Briscoe et al., 2006): the desire for IDW and for IOM, each triggering different career mobility behavior. While IDW increases the wish to switch professions, IOM increases the wish to switch organizations. This division deepens understanding of why research on boundaryless careers has so far revealed varied effects on job and career outcomes, specifically on organizational commitment. While the desire for IDW does not necessarily influence organizational commitment, the desire for IOM significantly decreases organizational commitment (Çakmak-Otluoğlu, 2012, Briscoe and Finkelstein, 2009).

High mobility in the IT labor market makes it relevant to investigate the boundaryless career concept in the IT industry. First, repeated organizational change was found to be prototypical for the IT profession (Joseph et al., 2012, Moquin et al., 2019, Eckhardt et al., 2016). Furthermore, IT professionals increasingly opt for turnaway, that is, for leaving the IT profession (Joia and Mangia, 2017, Joseph et al., 2015, Armstrong et al., 2015). Therefore, IT workforce research on turnover and turnaway contributes to greater understanding of organizational and professional mobility among IT professionals. While both types of career mobility have been highly researched with IT professional samples, we are not aware of any IS paper that investigates boundaryless career plans of IT students. Since with Generation Y, an increase in flexible careers is expected (Suleman and Nelson, 2011), the study of BCAs and their impact on current IT students' career plans promises better understanding of IT careers' future development.

2.2 Professional Identification

PI refers to the degree to which individuals define themselves as members of a profession (Wan-Huggins et al., 1998), thus providing a reference to help professionals make sense of their work and, to some extent, the essence of their lives. As part of identity theory (Ashforth et al., 2007), PI explains how individuals incorporate the values and attributes of the profession into the self-identity (Loi et al., 2004), which consequently highly influences human motivation (Hogg and Terry, 2000). Research has shown that PI is formed not only with the actual practice of the profession, but already in the first years of education (Clouder, 2003, Anderson-Gough et al., 2018). Through professional socialization, (future) members of professions get to know their professional values and attributes (Pratt et al., 2006, Kowtha, 2018). Research on PI hints to its positive influence on various job/career outcomes. It for example improves job satisfaction (Russo, 1998, Brooks et al., 2015), organizational commitment (Loi et al., 2004) and positively relates to intrinsic and extrinsic career goals (Greco and Kraimer, 2020).

IT workforce research has identified PI as part of the occupational culture in IT (Guzman et al., 2008, Dinger et al., 2015, Riemenschneider and Armstrong, 2021). Hence, IT professionals are characterized by a strong identification with their profession (Riemenschneider and Armstrong, 2021, Carter and Grover, 2015). This strong identification with IT was found to have different effects on mobility behavior of IT professionals. First, Dinger et al. (2015) discuss that identification with the profession can increase the perception of available job alternatives, and may consequently drive the intention to quit. Second, Brooks et al. (2015) demonstrate a negative influence of PI on turnaway intention via the moderators' job satisfaction and affective commitment. These findings suggest that PI decreases turnaway, while it increases turnover of IT professionals. Organizations must therefore consider the advantages and disadvantages of measures to increase professional identification of their IT workforce (Dinger et al., 2015).

2.3 Turnaway Intention

The IT profession has suffered from high turnaway rates for years – meaning that over the course of their careers, a high proportion of IT professionals leave the profession (Armstrong et al., 2015, Joia and Mangia, 2017). Research on IT turnaway hints at various causative mechanisms. Because IT career success is still often equated with responsibility for personnel, many IT professionals decide to climb the corporate ladder by switching to managerial positions (Joseph et al., 2012, MacCrory et al., 2016). Second, the IT profession imposes high demands in workload and working hours (Rutner et al., 2008), leading to such negative psychological consequences as stress and burnout (Pawlowski et al., 2007) or work exhaustion (Armstrong et al., 2015), eventually increasing turnaway risk. However, leaving a profession also entails high transition costs (e.g., training) and a correspondingly high risk during career transition (Ng and Feldman, 2007). Weighing turnaway's risk is therefore an essential element in employees' decision-making process.

IT professionals' turnaway has often been studied as a consequence of job characteristics and experiences (Armstrong et al., 2015, Joseph et al., 2015, Brooks et al., 2015). However, the theory of

boundaryless careers provides a framework to study turnaway as a planned career transition. In this paper, therefore, we examine IT students' plans to leave the IT profession during their careers and investigate the role of BCAs and PI in these plans. Rather than trying completely to avoid future boundaryless IT professionals' career transitions, researchers and companies might want to initiate alternative methods of providing career development for future IT professionals with BCAs. Near our conclusion, therefore, we provide recommendations on how best to employ different types of IT students with BCAs.

3 Hypotheses Development

To explore the relevance of BCAs and PI in relation to future IT professionals' career plans, we examine both concepts and their impact on IT students' turnaway intention. To investigate known influences of IT professionals' turnaway, we integrate the control variables of age, gender, satisfaction with study program, and perceived after-graduation career prospects. Figure 1 illustrates our research model. In the following, we explain the individual hypotheses in detail.

3.1 Direct Effects

Individuals who hold BCAs have a) a high preference for IDW, and/or b) a high preference for IOM. We propose that these two attitudes have contrasting effects on the turnaway intention of IT students.

Preference for interdisciplinarity and new experiences is characterized by enjoyment of working with other disciplines and the active search for constant challenges (Briscoe et al., 2006). Individuals with this type of BCA derive satisfaction from being challenged and collaborating with others while maintaining active relationships beyond organizational and disciplinary boundaries (Briscoe et al., 2006). We suggest that IT students holding this type of BCA plan to seek jobs and follow careers that involve boundary-spanning activities (Rutner et al., 2011, Niederman et al., 2016) and therefore require a high level of interaction with representatives outside IT. Such interaction enables them to foster networks outside the IT profession, thereby reducing barriers to moving to other functional areas (Joia and Mangia, 2017). In addition, these individuals seek new experiences and challenges in their jobs (Briscoe et al., 2006). Because of eagerness for new challenges, we suggest that IT students preferring interdisciplinary work and new experiences are relatively open to career transitions and consider moving into disciplines outside of their field of study. Due to preference for working with other disciplines and eagerness for new challenges, we hypothesize:

H1a: *Preference for interdisciplinary work and new experiences increases IT students' turnaway intention from IT.*

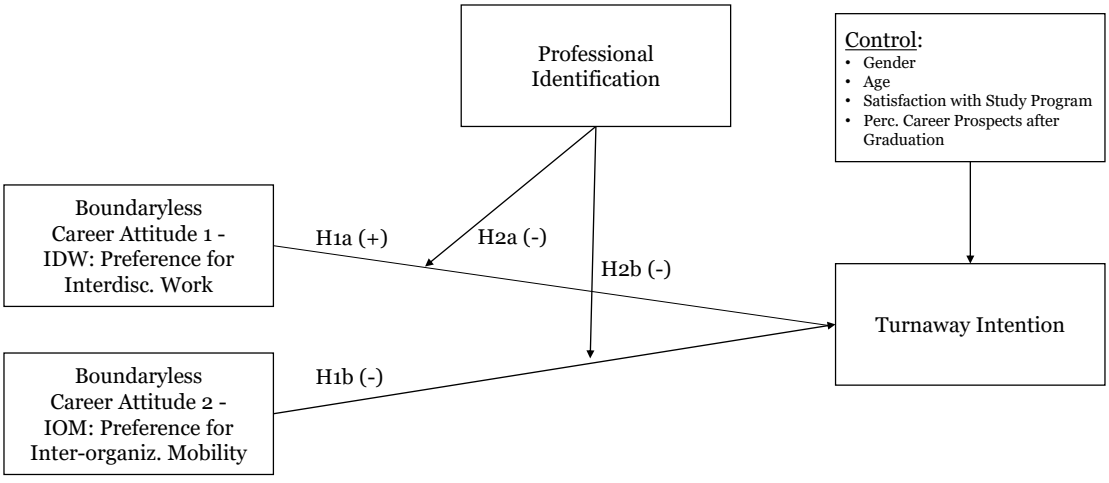

Figure 1. Research Model on Interactions of Boundaryless Career Attitudes and Professional Identification and Their Influence on IT Students' Turnaway Intention from IT

A preference for IOM is characterized by the desire to gain versatile experience through regular career transitions between organizations (Arthur, 1994). Individuals with organizational mobility preference therefore forgo the security of a single employment and regularly seek new opportunities in new organizations (Briscoe et al., 2006). We suggest that these IT students use regular, organizational transitions to advance their careers inter-organizationally and do not necessarily wish for advancement outside IT (Sullivan and Arthur, 2006). Instead, we propose that if IT students plan frequent moves between organizations, they may want to do so within the IT profession for the following two reasons.

First, the IT profession provides the perfect framework for regular organizational transitions (Joseph et al., 2012). Due to high demand and their skills' inter-organizational portability, IT professionals can easily and regularly switch employers (Ferratt et al., 2005, Ang and Slaughter, 2004). Second, switching organizations without simultaneously switching professions reduces transaction costs (e.g., training) and the risk of a failed career transition (Ng and Feldman, 2007). We therefore propose that IT professionals with IOM choose the lower-risk career transition between organizations and use IT skills' transferability between organizations to increase the likelihood of a successful career transition (Ng and Feldman, 2007). Given the many employment opportunities in IT and lower risk from organizational mobility, we suggest that this group of IT students uses the IT profession as a safe haven fulfilling their preference for inter-organizational experiences. Thus, we hypothesize:

H1b: *Preference for inter-organizational mobility decreases IT students' turnaway intention from IT.*

3.2 Interaction Effects

We propose that PI moderates the relationship between BCAs and IT students' turnaway intention. High PI allows professionals to feel as a part of a professional group, which eventually makes it more difficult for them to leave the profession (Brooks et al., 2011, Hogg and Terry, 2000). Since PI is formed in early years of education (Clouder, 2003, Anderson-Gough et al., 2018), we propose that PI has significant influence on IT students' career plans. Hence, we suggest that PI a) reduces the effects of the preference for IDW and b) enhances the effects of the preference for IOM on turnaway intention

First, we suggest that strong PI binds future IT professionals to their profession, even if they have a desire for IDW. We propose that among these IT students, those with a simultaneously high level PI will pursue their wish for new experiences within, rather than outside, the IT profession. Thus, they will plan to avail themselves of the many boundary-spanning activities the IT profession entails (Rutner et al., 2011, Niederman et al., 2016) and to target interface functions within the IT profession instead of planning to leave it. Since PI is a major factor influencing turnaway in IT (Brooks et al., 2011), we hypothesize:

H2a: *Professional identification moderates the relationship between preference for interdisciplinary work and turnaway intention such that it buffers (decreases) the increasing effect of interdisciplinary work on turnaway intention from IT.*

We further suggest an amplifying effect of PI on the relationship of IOM preference on turnaway intention. IT students with high PI and the desire to move between organizations are attracted to the IT profession because they feel a strong calling to the profession (Dinger et al., 2015) and because the IT profession offers ample opportunities to transfer quickly and frequently between organizations (Ferratt et al., 2005, Ang and Slaughter, 2004).

Easy transfer of IT skills from one organization to another (Ferratt et al., 2005) will provide a safe zone for future IT professionals to move up the career ladder across organizations. We suggest that high PI will further encourage these IT students in their plans not to leave IT and instead plan their careers inter-organizationally. Thus, we hypothesize:

H2b: *Professional identification moderates the relationship between preference for inter-organizational mobility and turnaway intention such that it enhances the decreasing effect of inter-organizational mobility on turnaway intention from IT.*

4 Research Method

To evaluate the proposed research model, we conducted an online survey and collected 180 responses from IT students in Germany. We then analyzed the research model using multiple linear regression analysis with moderation. In the following, we explain the survey and the data collection and analysis.

4.1 Survey Development

For survey development, we followed published studies that targeted students (Adams et al., 2006, Briscoe et al., 2006). We used only pre-tested and published scales, that – when possible – were specifically designed for or had already been tested with student samples. If this was not possible, we adapted items to our study's specific context through small changes, such as adding "after graduation" to the questions (see example for Perceived Career Prospects in Table 1).

Table 1 provides an overview of the scales used. For IDW and IOM, we used two scales with four items each by Briscoe et al. (2006). PI was measured with a six-item scale, specifically designed for students by Adams et al. (2006). For turnaway intention, we adapted a four-item scale used by Brooks et al. (2015). For satisfaction with study program, we adapted a job satisfaction scale by Morris and Venkatesh (2010). Perceived career prospects after graduation was measured with a four-item scale by Weng et al. (2010). All items were rated on a 7-point Likert scale, from "1" = "Strongly disagree" to "7" = "Strongly agree".

4.2 Data Collection

For investigating our research questions, we defined our target group as IT students currently enrolled in one or more of the following study programs: computer science, software engineering, games engineering, information systems, data engineering, media informatics, robotics, and other similar programs. In early December 2020, we sent the questionnaire to approximately 700 IT students at three German universities offering the study programs listed above. We contacted students via email (e.g., mailing lists) or social media (e.g., student groups). Students received no recompense for completing the survey. Rather, we indicated the study's scientific purpose and emphasized that the survey was anonymous and voluntary. The survey remained open for one month. In total, we collected 301 responses (rate = 43%). We decided to use only full responses for this survey and accordingly reduced the sample to n=180.

Type	Construct	Source	Example
Independent Variables	IDW – Preference for interdisc. work	(Briscoe et al., 2006)	I enjoy tasks that require me to interact with people in many different disciplines.
	IOM – Preference for inter-organiz. mobility	(Briscoe et al., 2006)	In my ideal career, I would work for several organizations, instead of just for one.
Moderator	PI – Professional identification	(Adams et al., 2006)	I can identify positively with members of the IT profession.
Dependent Variable	TAI – Turnaway intention from IT	(Brooks et al., 2015)	It is likely that I will also explore career opportunities outside of the IT profession.
Control Variables	Satisfaction with study program	(Morris and Venkatesh, 2010)	Overall, I am satisfied with my study program.
	Perceived career prospects after graduation	(Weng et al., 2010)	With my skills and competence, it will be very easy to find a suitable job after graduation.

Table 1. Survey Development

We suspect that the questionnaire's extensive length combined with the survey's voluntary nature resulted in this rate of non-completion. However, with 180 full responses, we are confident that we collected a representative sample of IT students.

Table 2 provides an overview of the sample's characteristics. The majority was male (77.2%), consistent with enrollment statistics of IT degree programs in Germany. Most respondents pursued a bachelor's degree (85.0%) and were in the final stages of their studies (third year or higher: 65.0%). Accordingly, the majority was from 21 to 23 years old (56.1%).

4.3 Data Analysis

To test the research model, we used multiple linear regression analysis with moderation (Cohen et al., 2013). As a software tool, we used SPSS v.26. First, we tested the scales for their reliability. Table 3, displays the included scales' descriptive and correlation statistics. All scales provided a coefficient alpha of at least 0.7, indicating acceptable or higher reliability (Nunally and Bernstein, 1994). Since we are aware of the consequences of multicollinearity, especially when analyzing interaction terms (Shieh, 2011), we decided to mean-center all independent variables (including control variables). We tested the model for variance inflation factors (VIF). The highest VIF was 1.479, indicating no issue with multicollinearity in our model (<5) (Cohen et al., 2013). In addition, before conducting the analysis, we checked for violations of the assumptions for regressions and tested for non-normal distribution of residuals (Cohen et al., 2013). After ensuring that no assumptions were violated, we built three models for linear regression. The first model covered the influence of the control variables on the dependent variable. In the second model, we added the independent variables, and, in the third model, we added the interaction terms.

	Characteristic	**N = 180**	**100%**
Gender	Female	34	18.9%
	Male	139	77.2%
	Other/na	7	3.9%
Age	18–20 years old	45	25.0%
	21–23 years old	101	56.1%
	24–26 years old	20	11.1%
	>26 years	14	7.8%
Degree	Bachelor	153	85.0%
	Master's or Similar	27	15.0%
Study Period	First Year	26	14.4%
	Second Year	37	20.6%
	Third Year	89	49.4%
	>3 years	28	15.6%

Table 2. Sample Demographics

Variable	**Reliability statistics**			**Correlation statistics**							
	Mean	**SD**	**Cronb. α**	**Age**	**G**	**SSP**	**CP**	**IDW**	**IOM**	**PI**	**TAI**
Age	-	-	-	1							
Gender	1.20	0.39	-	-0.06	1						
SSP	5.45	1.09	.885	-0.12	0.05	1					
PCP	5.79	0.84	.729	0.08	-0.29**	0.35**	1				
IDW	5.55	1.06	.826	0.08	0.04	0.20**	0.28**	1			
IOM	4.12	1.42	.888	0.14	0.01	-0.04	0.24**	0.43**	1		
PI	4.74	1.14	.911	-0.01	-0.13	0.32**	0.16*	-0.08	-0.27**	1	
TAI	4.15	1.30	.867	0.13	0.07	-0.25**	0.06	0.23**	0.17*	-0.49**	1

Table 3. Descriptive and Correlation Statistics

DV: Turnaway Intention, n = 180			
Variable	**Model 0**	**Model 1**	**Full Model**
IDW – Preference for Interdisc. Work		.300*	.285*
IOM – Preference for Inter-Org. Mobility		-.152	-.153*
PI – Professional Identification		-.482***	-.535***
Gender	.141	.081	.084
Age	.070	.048	.028
SSP – Satisfaction with Study Program	-.317***	-.206**	-.236**
PCP – Perc. Career Prospects after Graduation	.209*	.164*	.153*
PI*IDW (interaction)			-.082
PI*IOM (interaction)			.202**
R^2	**0.107**	**0.371**	**0.405**
Significant codes p-value: *** : <0.001; ** : <0.01; * : <0.05 To enhance ease of interpretation, we report standardized coefficients.			

Table 4. Results of Regression Analysis

5 Results

To test our research model, we followed hierarchical regression approaches and created three models. Table 4 provides an overview of the models and their results. The base model (Model 0) provides information on the influences of the four control variables on the dependent variable turnaway intention. Satisfaction with study program (β=−.317, <0.001) and perceived career prospects after graduation (β=.209, <0.05) influenced turnaway intention significantly. Age and gender had no significant influence.

We then added the independent variables (Model 1) and their interaction terms to the model (Full Model). IDW had significantly increasing influence on turnaway intention (β=.285, <0.05), indicating that students with preference for interdisciplinarity had higher intention to leave the IT profession at some point in their careers. Thus, H1a is supported. Furthermore, the results revealed a significant reducing effect of IOM on turnaway intention (β=−.153, <0.05), indicating that IT students who plan their careers in several organizations have significantly lower risk of leaving the IT profession. Thus, H1b is supported. Furthermore, the results demonstrate a significant reducing, direct effect of the moderator variable PI on turnaway intention (β=−.535, <0.001). The values for control variables remained stable, evidencing the Full Model's robustness.

The interaction terms revealed interesting results. We could not find a moderating influence of PI on IDW -> turnaway intention. Thus, H2a is not supported. Furthermore, we found a significant, positive moderation of PI on IOM –> turnaway intention (β=.202, <0.01). This interaction indicates that the effect of IOM on turnaway intention is less negative with high PI. Thus, the results reveal the opposite moderation effect of what we were expecting. Consequently, H2b is not supported. Figure 2 shows the results graphically.

6 Discussion

In the following, we describe our study's key findings by deriving examples of boundaryless IT students and providing recommendations on how organizations can best employ them.

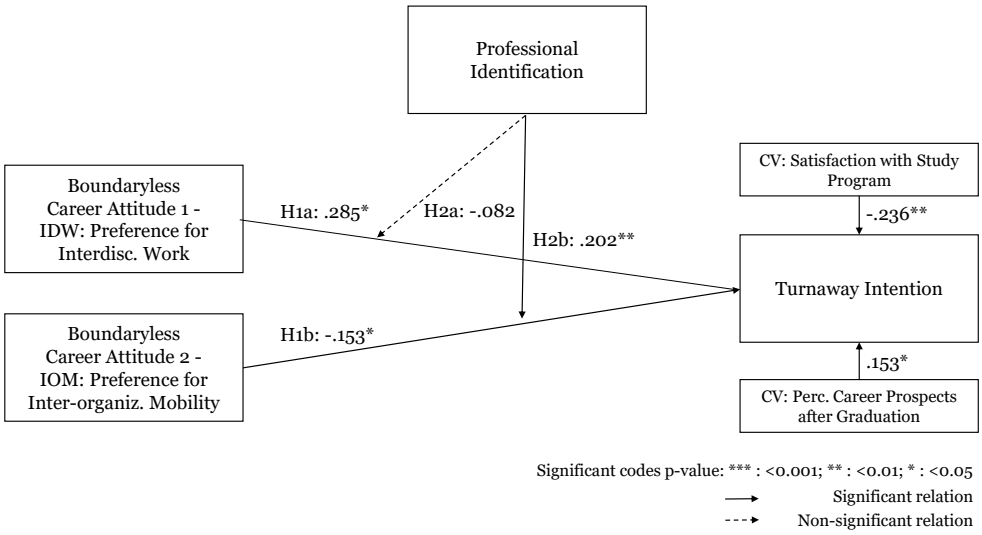

Figure 2. Results of Research Model

6.1 Key Findings and Insights

The results of the model showed that IT students with a preference for IDW are more likely to plan to leave the IT profession (H1a-supported). However, this relationship was not influenced by PI (H2a-rejected). We interpret this to mean that the preference for interdisciplinary experiences is so strong that this desire inevitably drives plans for exploration of career opportunities outside IT, regardless of PI degree. Furthermore, the results show that students with a preference for IOM plan their careers within IT (H1b-supported). We propose that the many job alternatives within IT keep these students in the IT profession. Thus, we suggest that students who hold IOM plan to use the IT profession as a safe haven to fulfill their desire for inter-organizational experiences. However, the significant positive interaction effect with PI (H2b-rejected) indicates that the effect of IOM on turnaway intention is less negative with high PI. We interpret that students with high IOM and PI are highly motivated to advance their careers in- and outside IT. With higher PI, their belief in successful transferability of skills increases, prompting them to use technical knowledge in other professions and to leave the IT field.

6.2 Examples of IT Students with BCAs and How Best to Employ Them

To provide pertinent discussion and illustrate the results with specific focus on this paper's practical relevance, we introduce four examples of IT students with BCAs and provide suggestions on how to employ them. Table 5 provides an overview the four examples. We derived examples according to the possible combinations of variables in the research model: *Example 1: The Adventurist* = High Levels of IDW + Low PI (H1a); *Example 2: The Connector* = High Levels of IDW + High PI (H2a); *Example 3: The Beneficiary* = High Level of IOM + Low PI (H1b); *Example 4: The Ambitious* = High Levels of IOM + High PI (H2b). In the following, we detail these combinations.

Example 1: The Adventurist - Preference for Interdisciplinary Work & Low Professional Identification

Description: Boundaryless IT students belonging to *Example 1: The Adventurist* are characterized by high IDW – preference for interdisciplinary work and new experiences (H1a) – and low PI, meaning they prefer interdisciplinary tasks, seek new professional experiences, and are driven by challenges without experiencing high identification with IT. IDW's significant influence on turnaway intention indicates that these students plan to avail themselves of career opportunities outside IT during their careers and will transition between disciplines. Their main inner driver is gaining interdisciplinary experience, independent of the IT field.

Name (Interaction)	**Description**	**Implications for IT careers and companies**
The Adventurist (High IDW * Low PI)	***Characteristics*:** High preference for interdisciplinary work and low professional identification ***Career plans:*** Consideration of leaving IT profession ***Motivation:*** Gaining interdisciplinary experiences, also outside IT	***Expectations for careers:*** These future employees will seek to explore and exploit different directions during their careers, including outside IT. ***Should be hired for:*** Interdisciplinary tasks and boundary-spanning activities in- and outside of IT ***Measures in companies:*** Offer career paths with interdisciplinary switches within company
The Connector (High IDW * High PI)	***Characteristics*:** High preference for interdisciplinary work and high professional identification ***Career plans*:** Consideration of leaving IT, but bound by high PI ***Motivation:*** Gaining interdisciplinary experiences inside IT	***Expectations for careers:*** These future employees will seek to explore and exploit different directions during their careers, in- and possibly outside IT. ***Should be hired for:*** Interdisciplinary tasks and boundary-spanning activities in IT ***Measures in companies:*** Offer IT jobs with plenty of interactions with other disciplines
The Beneficiary (High IOM * Low PI)	***Characteristics*:** High preference for inter-organizational mobility and low professional identification ***Career plans:*** Switching between organizations but within IT ***Motivation:*** Using IT as a secure playground with additional benefits to switch between organizations	***Expectations for careers:*** These future employees will seek to explore inter-organizational experiences by switching between organizations. ***Should be hired for:*** Work with little onboarding time and required external knowledge ***Measures in companies:*** Offer movement between subsidiaries, short-term jobs for workers free to leave after the project (e.g., project work)
The Ambitious (High IOM * High PI)	***Characteristics:*** High preference for inter-organizational mobility and high professional identification ***Career plans:*** Switching between organizations with possible changes out of IT ***Motivation:*** Gaining inter-organizational experience combined with high personal growth need	***Expectations:*** These future employees will seek to explore inter-organizational experiences while also considering a transition to other professions. ***Should be hired for:*** Fast-paced interdisciplinary groups, possibility for hiring as boomerang employees and for management positions ***Measures in companies:*** Offer experience outside of organization (e.g., subsidiaries, expat arrangements) and flexible reentry.

Table 5. Examples of IT Students with Boundaryless Career Attitudes

Implications: Companies must expect that these future employees will seek to explore and exploit different directions during their careers. As this example of boundaryless IT students might gain exceptional value for the company due to their interdisciplinary knowledge (DeFillippi and Arthur, 1994), companies should not miss to offer career paths with possible interdisciplinary switches within the company. By providing fluid transitions between different within-organization jobs, companies could benefit significantly because, over the course of their careers, these employees offer considerable knowledge in different directions (Sullivan and Arthur, 2006, Tams and Arthur, 2010).

Example 2: The Connector – Preference for Interdisciplinary Work & High Professional Identification

Description: Boundaryless IT students belonging to *Example 2: The Connector* are characterized by a high preference for IDW and a high level of PI (H2a), meaning they prefer interdisciplinary tasks, while feeling highly connected to IT. Even if PI does not significantly influence the relationship between IDW and turnaway intention, this group has a significant, lower risk for turnaway due to the strong direct influence of PI on turnaway intention (Brooks et al., 2015). Their main inner driver is to gain interdisciplinary experience during their career, inside and potentially outside the IT field.

Implications: Companies must expect that these future employees will seek interdisciplinary experience during their career in IT. Due to the high affinity to IT and the wish to interact with others, this type of employee is the perfect connector between IT and other disciplines. Companies should therefore employ these boundaryless IT students primarily for boundary-spanning activities and interdisciplinary tasks to satisfy their preference for interdisciplinary work through frequent interactions with other disciplines.

Example 3: The Beneficiary - Preference for Inter-organizational Mobility & Low Professional Identification

Description: Boundaryless IT students belonging to *Example 3: The Beneficiary* are characterized by high preference for IOM (H1b), meaning they plan to switch organizations during their careers. However, this group has significantly reduced risk of leaving the IT profession. Because they do not exhibit a high PI level, PI does not influence their plans to remain in IT. Rather we suggest that this group of students is determined to stay in the IT field because of its benefits. For example, they might want to benefit from the good pay, prestige, and job security that the IT profession entails (McKnight et al., 2009). We also suggest that *Beneficiaries* use the high demand for IT professionals for easy transitions between organizations. Thus, we propose this group of IT students uses IT as a secure haven, with additional benefits, to fulfill their need to switch organizations.

Implications: Companies must expect these future employees to follow their plans to switch organizations. At first glance, this appears disadvantageous for organizations, but it also brings considerable advantages, especially in terms of experience from other companies (Ferratt et al., 2005). Companies should hire these employees primarily for work with little onboarding time and the need for extraordinary solutions. After all, these employees will have a high level of IT knowledge since they do not tend to switch professions. In addition, these employees bring external knowledge from other companies, from which the organization can benefit significantly.

Example 4: The Ambitious - Preference for Inter-organizational Mobility & High Professional Identification

Description: Boundaryless IT students belonging to *Example 4: The Ambitious* are characterized by high preference for IOM and high PI (H2b). While PI might be expected to enhance IOM's decreasing influence on turnaway intention, that influence is increased by the interaction term, implying that IOM's effect on turnaway intention is less negative with high PI. We propose that this group consists of ambitious IT students who prefer IOM, in combination with high need for personal growth. While they strongly identify with the IT profession, they are also more willing to leave it because their advanced technical skills reduce the risk of a failed career transition and make it easier to change organizations and professions (Ng and Feldman, 2007). In combination with a high need for personal growth resulting from PI, we suggest that these IT students might follow the impulse to benefit from their technical skills in other professions and management positions.

Implications: This example of boundaryless IT students is characterized by a high degree of mobility from which companies can benefit. These future employees connect to the IT profession, while benefiting from knowledge within and outside IT, as well as from other companies. Companies should offer career paths involving experience outside the organization, for example, through contracts with subsidiaries or as expats. Furthermore, companies might recruit them for management positions and as boomerang employees (Maier et al., 2021).

6.3 Theoretical Contribution

We see this study's theoretical contribution in the following three research areas. First, by investigating BCAs and demonstrating their influence on career plans in the IT context, we contribute to research on IT careers (Joia and Mangia, 2017, Joseph et al., 2012) and on IT turnaway (Armstrong et al., 2015, Brooks et al., 2015, Joseph et al., 2015, Reich and Kaarst-Brown, 1999). While career transitions in IT are often viewed as a consequence of job characteristics and experiences at work (Armstrong et al., 2015, Joseph et al., 2015, Brooks et al., 2015), BCAs provide a framework for examining occupational

and organizational transitions in IT as planned rather than as individuals' reactive behavior. Our study thus extends the literature on the IT profession's boundaryless characteristic (Ituma and Simpson, 2009, Joseph et al., 2012) and paves the way for further research on understanding career transitions away from, but also potentially toward, the IT profession (late-entry IT professionals (Joseph et al., 2012)).

Second, we generate greater understanding of BCAs' impact on current IT students and thus contribute to better understanding of the next generation of IT professionals (Setor and Joseph, 2016, Prommegger et al., 2020a, Setor and Joseph, 2021). With our study, we illustrate how IT professionals' career planning does not begin when they enter the workforce; instead, IT students develop preferences for career development during their studies through interaction with colleagues and teaching staff and through initial professional experiences in IT, for instance, practical courses and internships. To the best of our knowledge, therefore, we are the first to demonstrate IT students' BCAs and their influence on career planning. Rather than only focusing on establishing measures to reduce turnover and turnaway in IT, our study calls for measures within universities, for example, mentorship or career planning (Setor and Joseph, 2021) and for measures in organizations such as designing promotion paths for future boundaryless IT professionals to promote young IT professionals' career persistence in IT.

Third, we contribute to research on PI in IT (Brooks et al., 2015, Brooks et al., 2011, Riemenschneider and Armstrong, 2021, Carter and Grover, 2015). While management literature suggests that PI begins to form during the educational years (Clouder, 2003, Anderson-Gough et al., 2018), PI among IT students and its' influence on the IT profession are underrepresentated topics in IS research. In line with IT workforce literature (Brooks et al., 2015), we found PI's strong association with plans to stay in IT and surprising interaction effects with BCAs. We are convinced that the interaction between PI and BCAs will also provide interesting findings for research on IT professionals. We therefore hope our study will encourage PI's investigation among IT students and future IT professionals, to help shape future IT careers.

6.4 Practical Contribution

We would like to dedicate our practical implications to two parties: organizations and universities.

For organizations, our paper provides suggestions on how to employ IT students with BCAs (see Table 5). Based on our research model, we suggest that IT students with different forms of BCAs, in combination with low or high PI, provide different mindsets and skills that can benefit companies in different ways. Because we expect increased boundaryless careers in IT (Joseph et al., 2012, Prommegger et al., 2020b), organizations will need to find ways to provide boundaryless IT professionals with opportunities for development. Our results suggest that the IT profession acts as a safe haven by offering opportunities for inter-organizational movement and flexible work. Therefore, we suggest that organizations leverage their boundaryless structures to attract talented individuals from other organizations and retain IT students and professionals in the field. Boundaryless IT professionals provide broad skills, beyond the profession and the organization, that can greatly benefit employers. Designing atypical career paths in organizations to integrate boundaryless IT professionals can thus pay off for organizations.

Lastly, we recommend universities address contemporary career concepts in their study programs. To fulfill needs of IT students holding BCAs, universities offering IT-related study programs should provide opportunities for IT students to work interdisciplinarily and interact with students from varied backgrounds. Personalized curricula and a wide range of electives from different study plans will provide plentiful opportunities for IT students to interact with others and at the same time enable creation of broad skill sets. Upon graduation, these future IT professionals will bring broadly diversified skill sets, a modern mindset, and self-motivation to companies. More so, despite IT students' predominant BCAs, PI still carries great influence on turnaway intention. Thus universities should develop programs to promote early PI either to keep future IT professionals in IT or to bring boundaryless IT professionals back to IT in the long term.

6.5 Limitations and Future Research

We recognize that IT students' career plans may change during their actual careers. Just as career anchors (Chang et al., 2011), BCAs may change over time, and PI may decrease or increase with work experience. Accordingly, we call for investigation of the relationship between BCAs and PI with a data sample of IT professionals. Furthermore, we recognize that the study's geographical and cultural context (Germany) might have influenced our results and findings. For example, since students in Germany do not pay tuition fees, they might be freer than others in their career plans and choices and, therefore, be more willing to risk high transaction costs when switching professions. Finally, we would like to raise awareness about the study's response rate (43%) and especially about the rate of students who started the survey but did not fill out all relevant questions for this study (n=121). We acknowledge that both these rates could have impacted our results. Thus, we call for replication with a larger sample in different geographic and temporal contexts.

Additionally, while there is research on boundaryless careers in IT (Ituma and Simpson, 2009, Joseph et al., 2012), we are not aware of any that examine IT students' BCAs and their impact on career planning. Our paper shows that IT students' BCAs can be identified at an early stage of their studies. Therefore, measures for boundaryless IT career design should be taken at an early stage, so future IT professionals do not only leave IT, but also find their way back to the IT field. Research on boundaryless IT careers and the emergence of BCAs among IT students can help with this design. We are particularly interested in the extent to which and when BCAs emerge among IT students and how they, for example, influence the choice of field of study.

Furthermore, we believe great potential lies in combining research on job characteristics and work outcomes that trigger career transitions (Armstrong et al., 2015, Brooks et al., 2015, Joseph et al., 2015, Reich and Kaarst-Brown, 1999) with research on BCAs for investigating turnaway in IT. Each research stream investigates IT turnaway from a different perspective. However, it stands to reason that both reinforce each other. For example, IT professionals with BCAs, when experiencing burnout or exhaustion, may exhibit lower barriers to moving away from IT since turning away would naturally benefit their desire for change. Therefore, we encourage research on interaction effects of job characteristics, work outcomes and BCAs in the IT profession.

Finally, we would like to note that the investigation of individuals' BCAs can not only improve our understanding of IT turnaway but also our knowledge about individuals' transitioning into the IT profession. Our understanding of "late-entry" IT professionals is still limited (Joseph et al., 2012), but given the ongoing IT skills shortage, this group has great potential in the current IT job market. The study of late-entry IT professionals' BCAs could help us better understand this group, their career paths, and their motivations to move into IT; then we could appropriately support late-entry IT professionals during their transitions (Prommegger et al., 2020b). We thus encourage future research on late-entry IT professionals.

7 Conclusion

Lack of understanding of BCAs' influence on future IT professionals' career plans motivated this study. Thus we examined IT students' BCAs and their relationship with students' plans to leave IT during their careers, along with whether PI shapes this relationship. We found divergent effects of two BCA forms on intention to leave the IT profession. While a preference for interdisciplinary work increases IT students' intention to leave, a preference for inter-organizational mobility lowers their intention to do so. Furthermore, we found surprising interaction effects of BCAs with PI. Contrary to our expectations, PI did not significantly reduce effects of preference for interdisciplinary work on turnaway intention. Moreover, we found positive interaction terms for PI and inter-organizational mobility on turnaway intention, indicating that higher PI reverses the reducing effect of preference for inter-organizational mobility on turnaway intention. Overall, this study contributes to research on changing IT careers and provides practical guidance for the employment of future IT professionals with BCAs.

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Agile and Attached: The Impact of Agile Practices on Agile Team Members' Affective Organisational Commitment

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Abstract. The current shortage of information systems (IS) specialists is leading to a strongly competitive labour market for the IT workforce. Technology companies need opportunities to prevent high replacement costs and knowledge loss by strengthening the affective organisational commitment (affective OC) of their employees. Using structural equation modelling, we investigate the influence of agile information systems development (ISD) on team members' affective OC. Our results demonstrate that agile project management (APM) positively predicts affective OC directly as well as indirectly via team members' job autonomy (JA) and their supervisors' support (SS). Our study gives empirical evidence on the relationship between agile ISD practices and affective OC and provides implications how to successfully leverage team members' affective OC. For practitioners, our research expounds why and how agile ISD is a suitable instrument to transform leadership culture within the company so as to raise affective OC beyond the IT workforce.

Keywords: Agile information systems development, affective organisational commitment, IT workforce, supervisor support, job autonomy

1 Introduction

Expenditure on IT is currently at its highest level and points to a new cycle of growth in the IT industry [1]. Consequently, the IT sector is now the strongest sector with respect to jobs in Germany, which is why IT professionals are in greater demand than ever before [2]. Simultaneously, the IT industry suffers from high labour fluctuation [3]. A current average turnover rate of 13.2% makes the software industry the unfortunate leader among all industries in this regard [4]. The consequences of turnover, such as high replacement costs and a significant loss of knowledge [3], indicate the need for measures that counteract the resignation of employees.

One main factor influencing turnover is organisational commitment (OC). Committed employees feel personally attached to their company [5], and therefore, they are willing to invest effort on behalf of the organisation [6]. To bind their employees, companies have to be attractive and convey values that employees regard as positive [7]. By introducing and living a culture within the company to which employees can

relate, they (the employees) identify with the organisation and satisfaction, engagement and performance increase [6].

Currently, a widely used method of sustainably modifying not only work processes but also values in the organisation is the introduction of agile information systems development (ISD). Using the concept of job redesigning, agile ISD practices influence job characteristics, as well as value constructs, and thereby, they change individuals' outcomes in terms of job satisfaction and motivation [8, 9]. We use this perspective of agility as a form of job redesigning to investigate the connection between agile practices and attachment by examining this question: "*What are the effects of agile project management (APM) practices on the affective OC of agile ISD team members*?"

We claim that agile ISD practices predict affective OC both directly and indirectly. First, agile practices interfere with values embedded within the organisation [10, 11], and consequently, they affect the value congruence and the identification of employees with the organisation. Second, by following the principle of self-organisation, agile ISD shifts responsibility to the team level, and at the same time, it provides a supervisor with the ability to support and protect the team in the face of difficulties [12, 13]. This rise of autonomy and supervisor support determines the commitment of employees to an organisation [14]. Using structural equation modelling, we aim to demonstrate the impact of agility both directly and indirectly on affective OC.

The paper is structured as follows. First, we explain the theoretical background research regarding agile ISD as well as affective OC. Second, we introduce the research model, as well as the hypotheses based on the literature review. Third, we describe the research method, as well as the study approach, and introduce the results of the structural equation model. Last, we discuss the implications and give further recommendations concerning affective OC in the context of agile ISD.

2 Theoretical Background

2.1 Agile Information Systems Development

Agile ISD is widely used in companies of various sizes and those belonging to various industries [15]. Within our paper, we define agile ISD as "the continual readiness of an information systems development method to rapidly or inherently create change, proactively or reactively embrace change, and learn from change while contributing to perceived customer value (economy, quality, and simplicity), through its collective components and relationships with its environment" [16]. The strength of agile ISD practices is decisive here: Agile approaches react to the challenges and needs of a fast-moving environment. By embracing change in projects, agility enables flexible planning, even when the scope of projects remains unstable [17].

At the employee level, agile ISD acts as an instrument for job design [8]. Agility improves team structures [18], reduces negative effects of subgroups [19] and influences job characteristics such as skill variety and task identity [8]. Furthermore, the ability to complete a whole task in the form of "user stories" leads to an increase in motivation, as well as ambition, to improve constantly [9]. Because of these factors, agile ISD influences the working processes of agile team members.

Agile ISD also causes an alteration in individuals' values and principles, changing the software development process fundamentally. In contrast to traditional development methods, agile ISD puts the focus on people and collaboration [11, 20]. Agile ISD trusts in self-organised teams that decide independently the extent and implementation of the requirements [21]. Equally, the supervisor assumes a coordinating and mentoring role [22]. This shift to flat hierarchies reduces cumbersome processes and makes agile teams faster and more efficient, allowing high-speed and top performance within the software development process [12, 13].

In our paper, we define an agile ISD team as a cross-functional team building and updating software, mostly using agile ISD practices and including members both focusing on delivering software as well as managing the team [8].

2.2 Affective Organisational Commitment

OC is "the relative strength of an individual's identification with and involvement in a particular organisation" [5] and consists of affective, normative and continuance commitment [23]. It is particularly important in the IT context as it has a great impact on turnover intention [38]. People with high productivity or fulfilment often perceive themselves as inseparable from their jobs. Consequently, their personal commitment to, and professional engagement with, the organisation for which they work is borne out [24].

Organisational culture and environment are strongly related to affective OC [25, 26]. The person–organisation fit and perceptions of congruence between worker and company sustainably influence employee commitment [27]. The more important values for an employee are reflected in the company the more the employee's commitment rises [28]. Therefore, the active management of embedded organisational culture and values has significant influence on retention.

Another essential point here is how decisions are made within the company. Informal culture and communication, as promoted within the context of an agile system, bind the team members in the form of an organisational family, and therefore, they foster OC [25, 26]. The empowerment to decide regarding work tasks gives an employee the opportunity to contribute to the success of the company, and consequently, it increases their interest in the enterprise's well-being [29, 30].

3 Research Model

The results of the literature review indicate the influence of agile ISD on affective OC beyond agile team members. In our study, we use our research model to investigate the impact of APM practices on affective OC. We hypothesise that APM practices influence affective OC in two ways. First, the impact happens directly through the embedding of positive, agile values into the organisation's processes, thereby affecting the person–organisation fit (H1). Second, the impact of APM practices occurs indirectly consequent to the change in leadership culture by affecting JA (H2a+b) and SS (H3a+b). **Figure 1** illustrates the research model.

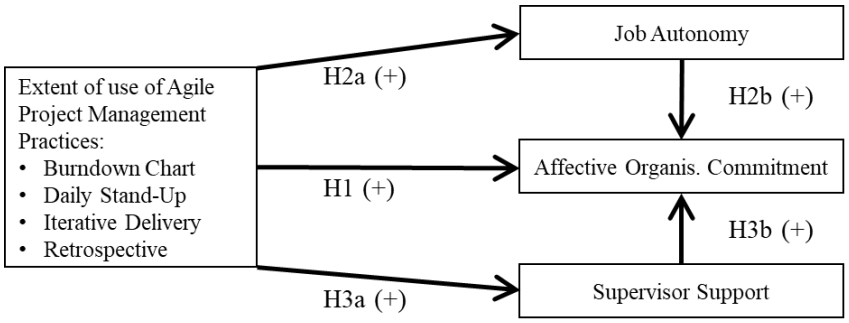

Figure 1. Research model

3.1 Direct Influence of Agile Practices on Affective OC

By promoting agile ISD within the company, the enterprise advocates positive agile values such as collaboration or customer involvement [10]. Retrospectives drive the team to constant reflection and at the same time improve the bond within the team. [31]. The principle of iterative delivery helps team members not only to see individual work packages, but rather to gain an overview of the entire development process [8]. Thus, an agile employee experiences a change at work under the umbrella of attractive and people-oriented values [20].

Agile values and principles play an essential role for agile teams. Williams [32] show that the majority of agile teams (65%) is not only committed to implementing agile practices, but rather to pursuing agile values. We suggest that this integration of agile values within organisational values influences the ways in which employees perceive their organisation. The advocacy of agile values in the company leads to an increased value congruence between employee and company, which implies an increased level of perceived person–organisation fit and supports identification with the enterprise [7, 33] , as well as OC [28]. Thus, we hypothesise the following: *H1: The use of APM practices positively influences affective OC of agile ISD team members.*

3.2 Indirect Influence of Agile Practices on Affective OC

JA, which is described as “the degree to which the job provides substantial freedom, independence and discretion in scheduling the work and in determining the procedures to be used in carrying it out” [34], has increased in the past few years within the IT sector . JA decentralises decision-making to those who actually carry out the work, and thus, it provides the team and the individuals with the flexibility to react faster to changes and unforeseen circumstances [15].

Self-organisation occurs at both the team and individual levels and is a decisive principle of agile practices [11, 13]. In accordance to [8] we suggest that agile methods support JA by combining the doing, the planning, and the controlling of the software development activities and providing the team with the possibility to manage a personal

client relationship [8]. Furthermore, agility trusts in the self-coordination of teams and follows a shared decision-making approach [21]. Contrary to traditional software development, where managers delegate, coordinate and supervise work, agile teams are encouraged to organise work independently and make decisions jointly. This principle is, for example, followed by the agile practice of iterative delivery, which encourages team-based estimations regarding workload [35]. Thus, we hypothesise the following: *H2a: The use of APM practices positively influences JA of agile ISD team members.*

JA, as one dimension of intrinsic rewards, positively influences self-disciplined and commitment-driven behaviours. These behaviours are expressed by the presence of hard work, voluntary initiative and the support of organisational objectives [36]. Workers who are self-responsible for the organisation and the coordination of their work are more closely associated with the company.

Furthermore, employees who are challenged with self-organisation at work experience greater well-being and job satisfaction. This is because JA lowers stress, increases motivation and enhances work engagement [8]. Self-organised employees develop a personal interest in the well-being of the company, and consequently, commitment rises and turnover drops [29, 30]. Thus, we hypothesise the following: *H2b: JA positively influences affective OC of agile ISD team members.*

Although agile ISD calls for self-organisation, it does not mean that leadership has become obsolete. To maintain a functioning team, organisational guidance and particularly the support of supervisors are still needed [11, 12, 37]. Agile development requires a new, changed image of managers. Instead of trite adherence to hierarchy and micromanagement, agile ISD calls for management styles that foster the collaborative self-management of teams [37].

Studies already show the positive effects of this new form of leadership. Windeler, Maruping and Venkatesh [38] provide evidence by investigating 73 ISD teams in which empowering leadership contributes to a reduction in role ambiguity, role conflict and stress, and thus, the authors of that study determine that this management style is a suitable measure against technical risk factors [38]. Tyssen, Wald and Heidenreich [39] show that task and people-oriented leadership behaviours in temporary organisations, such as IT projects, are aimed above all at follower commitment in projects, thus having indirect effects on project success [39].

We consider this shift in management styles as beneficial and claim that the change to self-organisation in agile teams does not compensate the need for organisational support; rather, it enhances the perception of SS. By carrying out retrospectives, the team is able to detect problems more quickly and forward them to their supervisor. The use of burndown charts also allows ongoing and rapid feedback from the manager. Thus, we hypothesise: *H3a: The use of APM practices positively influences perceived SS of agile ISD team members.*

Organisational support is one essential key driver of affective OC [40]. By fulfilling socioemotional needs as affiliation and fostering the norm of caring, employees feel the obligation to improve performance and care about the organisation’s welfare [41]. Consequently, employees perceive a higher level of satisfaction with their jobs and are more committed to their organisation.

SS, as one dimension of organisational support, reflects the connection between organisational support and affective OC [14, 41]. On the basis of the perceived identification of a supervisor with their organisation, managers act as organisational agents. Therefore, supervisors who appear to be valued by their organisation can highly influence the perceived organisational support of employees [14]. Consequently, we claim that the link between organisational support and commitment can also be transferred to the sub-dimension of SS. Due to flat hierarchies and close cooperation in agile ISD, we suggest that this effect might even be intensified and therefore, we hypothesise the following: *H3b: SS positively influences affective OC of agile ISD team members.*

4 Research Method

4.1 Study Design

Our study was conducted in cooperation with a German company operating in the automotive industry. The company employs approximately 130,000 workers, 4,500 of whom can be allocated to the IT function. The IT organisation strives for a holistic, agile approach, and therefore, it introduced company-wide agile practices in 2016.

We decided to perform the study with the aid of structural equation modelling (SEM). Because of the unestablished character of the theory and the occurrence of 2nd order constructs within the model, we chose Partial Least Squares Structural Equation Modelling (PLS-SEM) over Covariance Based Squares Structural Equation Modelling (CB-SEM) and selected SmartPLS as the software tool [42, 43]. As a foundation for the procedure, we used the instructions of [43].

4.2 Participants and Data Collection Procedure

Due to restrictions, it was not possible to survey the entire IT department of the cooperating company and therefore we had to limit to a smaller target group. To capture a wide range of agile approaches, we intended to reach employees engaged in software engineering, with various degrees of agile experience and with different roles within the teams. On the basis of these parameters, we sent the survey to 380 potential candidates from different departments that use agile methods.

The survey achieved 172 responses, representing a response rate of 45%. The company in which the study was carried out works in close cooperation with external service providers because of which the company employs many people at managerial positions internally. It is, therefore, not surprising that around half of all respondents (52%) stated that they hold project managerial positions, such as Scrum Master Product Owner. The rest of the respondents were Business/System Analysts (15%), Software Developers (9%) and those in other positions (12%). In addition, 12% of all participants belonged to senior management. Most of the respondents had started to use agile methodology within the last 1.5 years (75%), while 6% had medium agile experience (1.5–3 years) and 12% had used agile practices for more than 3 years.

4.3 Measures

For the study, only established measures published in prior research with good quality criteria were chosen. To measure the extent of APM practices, we oriented on [8]. In order to investigate the most common agile practices we conducted a pre-survey within the company with 15 selected representatives from different divisions, with various roles and different degree of agile experience. The pre-survey revealed that iterative delivery (ID), daily stand-up (SU), retrospective (RE) and burndown chart (BD) were the most applied methods in the cooperating company (80 % of all respondents used ID and SU, 70 % used RE and 50% used BD), which is why we decided to integrate these practices in our survey. To assess JA, we used the scale from the job diagnostic survey by [34]. SS was measured using the five-item scale of [44]. For the assessment of affective OC, we used a scale from [45]. All items asked for the participants' agreement on a 7-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree).

4.4 Model Analysis

We built the structural equation model based on our research model. In accordance with [8], we defined the construct "APM Practices" as a reflective–formative 2nd-order construct, compounding burndown chart, iterative delivery, retrospective and daily stand-up. The other scales were modelled as reflective as proposed by the respective authors.

Following [46] and [47], we used a multilevel approach for assessing the structural equation models in order to analyse the added effects of agile practices on the suggested model. First, we modelled the direct effects of JA and perceived SS on the dependent variable affective OC (Model 1). Collectively, the manifest variables explained 24.2% of the variance of affective OC. When we included the agile practices (Model 2), the variance of affective OC increased to 26.9%. To test whether this increase was significant, we followed the instructions of [46] and calculated $f^2 = (R^2_{Model2} - R^2_{Model1})/(1 - R^2_{Model2})$. Afterwards, we performed a pseudo F-test ($f2*(n - k - 1)$)[1] [48]. The results indicated a significant change in R^2 ($F = 4.65$, df: 1, 130), which lets us conclude that the construction of the model is valid.

Subsequently, we evaluated the measurement model by conducting tests for internal consistency reliability, convergent validity and discriminant validity. The results of Cronbach's alpha, composite reliability and AVE can be found in **Table 1**. Cronbach's alpha of Retrospective, as well as composite reliability of Retrospective and Supervisor Support showed a critical value of > 0.95. However, in order to avoid losing informative value of the scales by deleting items, we decided to keep the scales as suggested and not to delete any items [43]. In addition, the outer loadings all exceeded the threshold of 0.7. Finally, the results of the cross-loading analysis demonstrated that all items loaded higher on the intended construct than they did on all other constructs, thus implying the construct's discriminant validity [49].

[1] * n = sample size, k = number of independent variables

Table 1: Reliability scores and AVE

		Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
BD	Burndown Chart	.874	.923	.799
ID	Iterative Delivery	.835	.901	.752
RE	Retrospective	.964	.976	.933
SU	Daily Stand-Up	.891	.933	.822
JA	Job Autonomy	.904	.938	.834
SS	Supervisor Support	.947	.960	.827
OC	Organis. Commitment	.820	.880	.648

To examine the validity of our formative 2nd-order construct, we followed the guidelines of [43, 45]. The assessment demonstrated that all 1st-order constructs significantly loaded on the 2nd-order construct. We, therefore, conclude that the modelling of our 2nd-order construct is valid.

Finally, we investigated collinearity, the Q^2 and the R^2 values, to provide evidence for the validity of the structural model. The inner VIF values were all clearly beneath the critical value of 5 and left no indication for a strong correlation between the predictor constructs [43]. Likewise, all Q^2 values, resulting from the blindfolding procedure, exceeded the value of 0, and thus, they provided evidence for the predictive relevance of the model [43]. R^2 of affective OC (0.269) implied a low effect [50].

5 Results

The path coefficient analysis provided evidence for the positive impact of the use of agile practices on affective OC. First, the results show that agile practices significantly and directly influence affective OC (0.201, $p < 0.01$).

This indicates that agile team members are more committed to their organisation. Thus, H1 is fully supported. Furthermore, we found confirmation for indirect links from APM practices to affective OC. JA was significantly influenced by the use of APM practices (0.262, $p < 0.01$), and furthermore, it (JA) impacted affective OC (0.212, $p < 0.05$). These results imply that agile teams perceive more autonomy in their work processes, which consequently leads to a higher level of commitment. Therefore, both Hypotheses 2a and 2b can be supported. In addition, the analysis demonstrated the significant influence of agile practices on SS (0.217, $p < 0.01$) as well as that of SS on affective OC (0.282, $p < 0.01$). Agile team members accordingly feel more supported by their direct supervisors; consequently, affective OC rises. Thus, Hypotheses 3a and 3b are fully supported. The results of the path analysis can be found in **Figure 2**.

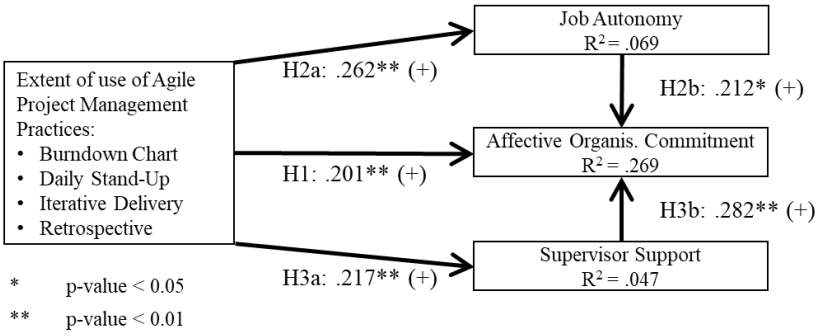

Figure 2. Path analysis results

6 Discussion

The findings of our study are in line with previous research [8, 35]. As with previous studies, we provide evidence for the existing conclusion that the extent of use of agile ISD practices positively predicts JA in agile ISD teams [8]. Furthermore, we reveal that team members of agile ISD teams gain high levels of support and empowerment from their supervisors [35].

We extend existing knowledge and provide insights that go beyond the results of previous research. When focusing on agile ISD practices, prior studies often investigated a particular practice, such as extreme programming or assessed agility, as a concept rather than investigating the extent of its use [51]. Most previous studies only investigated perceptions of work such as job satisfaction [8] and motivation [52]. The present study theorised and validated the effect of the use of agile ISD practices on JA, SS and affective OC. The results show that agile ISD practices have a direct effect on affective OC. In addition, affective OC is indirectly influenced by JA and SS. These additional insights provide several theoretical and practical contributions, which we explain in the following.

6.1 Theoretical Implications

The current research focuses on assessing the motivating and satisfying potential of agile ISD practices [8, 52]. Our theoretically conceptualized and validated research model is the first step in research on agile ISD to consider affective OC as a direct and indirect outcome variable and investigate how JA and SS predict affective OC. Thus, the contribution of our paper to existing literature is threefold.

First, our study contributes by theorizing and validating that agile ISD practices positively effects team members' affective OC. Analyzing the data with structural equation modeling, we show that there is a direct positive relationship between agile practices and affective OC in agile ISD teams. Thus, our paper extends existing knowledge on the effect of agile ISD practices on job perceptions of agile team members. The relationship between agile practices and team motivation was

investigated by [52]. As well, Tripp, Riemenschneider and Thatcher [8] found that team members are more satisfied if agile ISD practices are used by showed that particular agile practices are related to job characteristics, such as skill variety and feedback. Therefore, we contribute to the agile ISD literature by indicating that in addition to increased satisfaction and motivation, team members are also higher committed to their organisation. By investigating affective OC in agile ISD teams, we also contribute to research on turnover of IS professionals in general [30]. Van Scotter and Motowidlo [36] found that affective OC is a valid predictor of employees' turnover intention. Existing studies often investigated teams using particular practices (such as Pair Programming [53]). This approach has gained critique as it does not assess the amount of use of agile practices, but rather the "high level concept of use of that method" [51]. Our study extends existing knowledge on agile practices as we measured the extent of use of agile practices, as suggested by [51]. In summary, we contribute to literature on agile by demonstrating that the extent of use of agile practices positively affects team members' affective OC.

Second, prior literature indicates that the extent of use of agile practices is positively related to team members' JA [8]. Our study replicates the findings in a conceptual manner [54] and shows a significantly positive relationship between the use of agile practices and team members' JA. As well, we found that JA positively affects affective OC in agile ISD teams. Based on previous literature indicating that self-organisation is a decisive principle of agile practices [11, 13], we theorized that the amount of agile practices positively predicts autonomy in agile ISD teams. The use of agile practices decentralizes decision-making to those who actually carry out the work, providing the team and the individuals with the flexibility to faster react to changes and unforeseen circumstances [15]. Thus, we argue that this principle of self-organisation is fostered when agile practices are used. As well, we theorized based on literature indicating that self-organised employees develop personal interest in the well-being of the company and, as a consequence, higher commitment [29], that JA predicts affective OC in agile ISD teams. Employees who are self-responsible for the organisation and the coordination of their work are more closely associated with the company. These theoretically derived effects have been proven within our study. Therefore, our study contributes to research as we replicate the results of [8] by indicating that the use of agile practices directly influences team members' JA. In addition, our results extend research focusing on affective OC [29] by revealing JA as a predictor of affective OC in agile ISD teams. Furthermore, the findings of our study extend prior literature on self-organisation and turnover such as [30] by providing evidence that JA significantly predicts affective OC in agile ISD teams. Moreover, our results also extend existing general literature on self-organisation of agile ISD teams such as [12], [13] and [22] by revealing that there is not only a direct effect of self-organisation on affective OC, but of JA on affective OC as well. In summary, we contribute to literature on self-organisation of agile ISD teams by providing evidence for a positive effect of agile practices on JA as well as a positive relationship between JA and affective OC.

Third, our study reveals that the use of agile ISD practices significantly influences team members' SS and this, in turn, predicts their affective OC. Hence, with an increasing amount of use of agile practices, team members gain more support from their

supervisor. As a result, when perceiving themselves as being highly supported by their leader, team members feel more committed to the organisation. The present paper contributes to existing literature such as [55], who state that empowering leadership is crucial for project performance in agile ISD teams, by demonstrating that agile practices significantly affect team members' perceived support by their supervisor. agile Moreover, we contribute to existing knowledge such as [38], who find that empowering leadership is related to lower role ambiguity, role conflict and stress in software development, by showing that perceived SS is also positively related to affective OC. By fulfilling socioemotional needs as affiliation and fostering the norm of caring, employees feel the obligation to increase performance and care about the organisation's welfare [41]. In consequence, they are more committed to their organisation. Additionally, we extent literature such as [39], who found that people-oriented leadership behaviours in IT projects are aimed at follower commitment, by revealing that SS positively predicts affective OC. Summarizing, the present paper contributes to agile literature and psychological commitment literature by revealing that agile practices positively affect SS, which in turn is positively related to affective OC.

6.2 Practical Implications

In addition to theoretical derivations, our study also provides insights for practitioners. The results of the study demonstrate that agile ISD significantly influences not only work processes but also the well-being of IT professionals. By means of APM methods, it is possible to influence the perception of employees towards their company. Through striving for agile principles, an employee finds a common basis with their organisation and feels more connected to their company.

In addition, the results highlight the impact of leadership in empowered teams. The study proves that autonomy in agile teams by no means makes leadership obsolete but rather puts it at the centre of the scheme of things. The results demonstrate that JA and SS are of equal importance for an employee. This indicates the necessary shift in the current leadership culture. Supervisors must position themselves in a supportive and protective function to further encourage the self-organisation of their teams. This concept enhances the well-being of individuals and retains employees for the long term.

6.3 Limitations and Future Work

We want to emphasise the importance of attachment in the IT environment, thus encouraging future work regarding affective OC in the IT context. In this regard, we want to draw attention to our limitations to correctly classify the interpretation of the results and simultaneously create space for future research. First, we point out the importance of an enriched replication of this study. Hypothesis 1 is based on the argument that the introduction of agile values leads to an increase in person-organisation fit, which consequently leads to a rise in organisational commitment. This reasoning was derived from research by [7] and [28]. Unfortunately, we were not able to measure the person-organisation fit aspect in our study. Furthermore, we would like to point out that the scales used only allow a measurement of the application of agile

practices, but at the same time do not indicate that agile values are actually adapted in the company. We consider the investigation of the influence of agile practices on person-organisation fit as an important field of research, which is why we recommend to inspect this in future research. Second, our study was explorative in character, and therefore, it includes modest R^2 values. Because of the explorative character of this study, these results are comprehensible. We compared the variance with other explorative research in the area of affective OC and found similar results [e.g. 33, 56] because of which we think that our study brings essential contribution to the current agility research. In future, a replication of the study with a bigger sample size could lead to results with higher variance. Finally, we would also like to point out the possibility of reverse effects in the model. As OC leads to positive behavior [57], we recognize that the extent of agile practices may also be affected by the appearance of affective OC. For future research we therefore also recommend an investigation of the interaction of the presented independent and dependent variables.

7 Conclusion

Our paper provides insights into the influence of APM practices on affective OC. Based on structural equation modelling, our results demonstrate (1) the direct impact of agile ISD on affective OC via affecting values within the organisation and (2) the indirect impact of agile ISD on affective OC via following the agile principle of self-organisation and the consequent fostering of JA and SS. Our study, therefore, sheds light on the effects of agile practices on affective OC, while emphasising the importance of empowered teams and their relationship with leadership in the IT context.

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The Training Paradox of IT Professionals Who Leaves, Who Stays?

Short Paper

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Abstract

Rapid technological change requires companies to invest heavily in the training of their IT staff, which has different effects on career mobility. Whereas training can bind employees to their organization and thus lowers risk for turnover, it can also increase employees' market value resulting in higher turnover. With this paper, we propose a theoretical model to examine the training paradox of IT professionals. We argue that the effects of training on turnover depend on the type of knowledge acquired and on the employees' commitment. We propose that training, which fosters non-portable knowledge, reduces turnover, and training, which fosters portable knowledge, increases turnover. Furthermore, we argue that organizational commitment mitigates the negative effects of portable training on turnover, while professional commitment magnifies them. By applying commitment theory in the training context, we provide a better understanding of the interactions of commitment, as well as of the training paradox of IT professionals.

Keywords: Turnover; Training; Information Technology Professionals; Professional Development; Commitment; Firm-specific Human Capital

Introduction

Rapid progress in the field of technology – software in particular - can result in the feelings of perceived obsolescence among IT professionals (Joseph et al. 2011; Zhang et al. 2012). This feeling refers to "the degree to which professionals lack the up-to-date knowledge and skills necessary to maintain effective performance in either their current or future work roles" (Ang and Slaughter 2000, p.23), and leads to potential negative results, like stress, anxiety, and career changes (Harden et al. 2018; Tsai et al. 2007). Since companies highly benefit from fast technological progress, but at the same time risk rapid outdating of technical skills of their staff, perceived obsolescence will become an urgent issue in every IT-related company in future. Creating measures against perceived obsolescence in IT should therefore not only be in the interest of the employee, but also the company.

Perhaps, because it mitigates perceived obsolescence, organizational training has been proven to be a successful way to empower and retain IT employees in companies (Ferratt et al. 2012). Training and development activities help employees acquire job-related skills, improve the match between the required skills of the employee and his or her capabilities, and increase job performance on the individual as well as on the unit level (Arthur Jr et al. 2003; Collins and Clark 2003; Van Iddekinge et al. 2009). Furthermore, by receiving training, IT employees become more able to cope with work-related stress and are less likely to leave the organization (Joseph et al. 2011).

However, training may also lead to turnover of particularly talented employees in IT. The fast pace of technological change has resulted in a sustained and growing demand for skilled IT professionals. For example, in the United States, the market for IT professionals is expected to increase by 10% until 2029 (Bureau of Labor Statistics 2020). Perhaps, because it difficult to secure new employees, the US technology and software industry invested a total of approximately $6 billion in employee training in 2019 (Freifeld 2019). By training these existing employees, firms risk increasing employee's market value and consequently turnover (see for example Joia and Mangia (2017)).

Hence, training presents a paradox, with companies anticipating positive effects for employee satisfaction and retention; yet, fearing those same employees will be more able to secure alternative employment. Due to these technological advances, companies will always be required to constantly train their employees, which at the same time will put them at risk of making their own employees attractive to competitors and consequently losing valuable IT staff and investment. Because we anticipate an even faster pace of technological progress, and as well as robust IT labor markets to persist, we aim to realize a deeper understanding of how training impacts career decisions of IT professionals. Hence, in this paper, we examine the training paradox of IT professionals. Specifically, we investigate: *How does training influence the turnover intention of IT professionals? Do different forms of training exert distinct influences on IT professionals' turnover intention? How does organizational and professional commitment of IT professionals influence the relationship between training and turnover intention?*

Theoretical Background

To understand the contradictory effects of training, we turn to paradox theory, which helps to resolve tensions, oppositions, and contradictions among explanations for the same phenomenon (Poole and Van de Ven 1989). Paradox theory has been applied to resolve contradictions in organizational and management studies (Smith and Lewis 2011), and we suspect, will help to explain IT training's contradictory outcomes.

Paradox Theory

Paradox theory was developed as an overarching theoretical perspective to investigate unresolved "tensions and their management across multiple contexts, theories, methodological approaches and variables" (Lewis and Smith 2014). The investigation of paradoxes has a long tradition in research (Handy 1995), however, as organizations currently become more global, complex and fast paced, organizational researchers more and more use the paradox lens as a meta-theory to investigate contradictory results for organizational and management studies (Smith and Lewis 2011). It is this form of contradiction of independent elements that builds the foundation of paradoxical studies. As described in Lewis (2000), researchers experience tension in their studies if the conflicting elements are logic when observed alone but become irrational when being observed simultaneously. While paradox theory has been heavily used to draw insights into organizational phenomena in organization and management studies in the last 25 years (Schad et al. 2016), it has rarely been used in studies at the individual or team level, which is why there are now an increasing number of calls for research into paradoxes at the individual and team level (Waldman et al. 2019). We follow these calls by exploring the training paradox at the individual level of IT professionals.

Poole and Van de Ven (1989) suggest three approaches for solving paradoxes: 1) distinguishing levels of analysis, 2) investigating different temporal aspect and 3) introducing new terms and components to the theory. For the first approach, researchers need to clarify the level of analysis (eg. macro level, micro level) to assess whether mismatches are a source of contradictory findings. For the second approach, researchers need to determine whether temporal separation result in tensions/differences which explains why the phenomenon differed over time. For the third approach, researchers need to add additional constructs to explain the observed tensions. Whereas the first two approaches assume that the theory is generally complete, but needs to be distinguished by level and time, the third approach assumes that there are essential components missing to resolve the paradox under investigation. Thus, researchers following the third approach resolve the paradox by extending theory.

In the last 10 years, the use of paradox theory has garnered more attention in IS research. As an example, paradox theory has frequently been applied to explain technology use. For example, Mazmanian et al. (2013) used paradox theory to explain their findings that email devices both promote and hinder autonomy (Mazmanian et al. 2013). Furthermore, the paradox theory is particularly well-established in privacy

research, where it is used to explain the tensions between the intention and the actual behavior of individuals regarding data protection and privacy online (Adjerid et al. 2018; Aivazpour and Rao 2020; Awad and Krishnan 2006). Paradox theory has also been used to explain organizational IS phenomena. For example, Carlo et al. (2012) used paradox theory to investigate the opposing effects of IT on mindfulness and recently, Brooks et al. (2020) discussed issues in globally distributed work, and apply concepts of paradox theory to suggest a model of tension evolution and management.

Clearly, applying paradox theory can help to enrich explanations for IS phenomena and to extend IS theories. With our study, we follow IS researchers and use the third approach (extending theory) to solve paradoxes. We argue that the different effects of training on turnover depend on the type of knowledge acquired and on the employees' commitment. By adding organizational commitment and professional commitment to models of IT training we aim to resolve the associated retention and turnover paradox.

Paradox of Training

Evidence from the broader HR literature suggests that training's effects can result in positive and negative outcomes for organizations. By acquiring essential skills for the company, training can, for example, lead to increased person-organization fit (Green et al. 2000; Mostafa and Gould-Williams 2014). Furthermore, training indicates that the organization is willing to invest in the skills of the employee which causes increased perceived support by the organization (Koster et al. 2011) and consequently reduces turnover.

However, training can also increase turnover. For example, the recognition of the training in the form of subsequent promotion is a decisive factor for the impact of training. Benson et al. (2004) investigated investments of companies in college education of their employees. Their results revealed that investment in college education only pays off when employees are promoted afterwards. However, if employees did not get a promotion after graduation, their willingness to leave the organization increased (Benson et al. 2004). Furthermore, characteristics of the training impact its effect on turnover intention. Sieben (2007) tried to resolve the paradox of training through moderators such as training intensity, specificity and funding. The study revealed that training generally leads to reduced job search behavior. However, under special circumstances these effects can be reversed, e.g. if training is not funded by the company (Sieben 2007).

The IT training literature has also yielded conflicting conclusions. Studies suggest that the training of IT professionals reduces turnover intention if the organization follows an industrial strategy and promotes the development of internal careers (Ferratt et al. 2005; Ferratt et al. 2012). Furthermore, firm-specific training increasees person-organization fit and lowers the risk for turnover (Wingreen and Blanton 2018). Consequently, perceived career opportunity within the organisation rises and employees are less willing to quit (Bertolino et al. 2011; Ferratt et al. 2012).

IT research has also found training can increase career mobility of IT professionals. IT professionals are more willing to quit when they have a high need for personal growth (Joia and Mangia 2017) or when they perceive training as work instead of play (Joseph et al. 2011). Also, when the organization cultivates commitment to the profession instead of commitment to the organization, training can lead to turnover (Ferratt et al. 2012). Finally, training which contributes to a general instead of a firm-specific skill set (eg. certifications) increases the risk for turnover (Cha and Quan 2011; Joia and Mangia 2017).

Although IS studies have dealt with the diverse effects of training on turnovers, to date, to the best of our knowledge no work has attempted to reconcile the IT training paradox, in a single study. We therefore aim to come closer to solving the paradox by examining different types of training on turnover and by extending training models to include two forms of commitment: organizational and professional commitment.

Hypotheses Development

Figure 1 illustrates our research model. We suggest that the influence of training on turnover intention is related to the type of knowledge, employees gain through their training. First, we suggest that training which fosters non-portable knowledge decreases turnover intention (H1a), and training which fosters portable knowledge increases turnover intention (H1b). Further, we suggest that these effects are moderated by different forms of commitment: organizational commitment (H2a-b) and professional commitment (H3a-b). In order to consider known influences of turnover of IT professionals in the model,

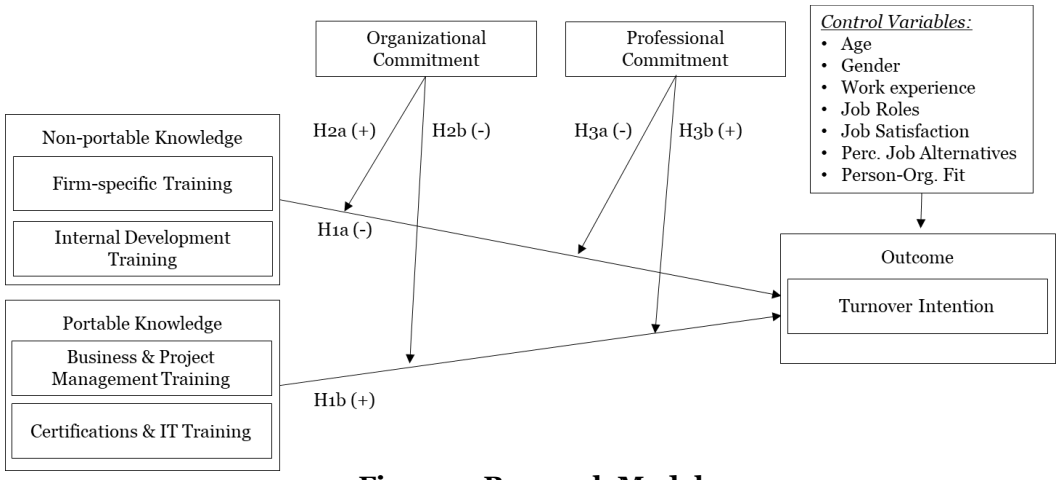

Figure 1. Research Model

we integrate the control variables age, gender, work experience, job roles, job satisfaction, perceived job alternatives as well as person-organization fit (Joseph et al. 2007). In the following we explain the individual hypotheses in detail.

Direct Effects of Training on Turnover Intention

The IT professionals rely on training to counteract the risk of professional obsolescence (Tsai et al. 2007). In these trainings they are taught different types of knowledge and skills, which we divide into two categories: non-portable knowledge and portable knowledge. We suggest that training has a different impact on turnover intention depending on whether the knowledge and skills acquired can be reused by the employee in another organization or not.

Table 1 gives an overview of different types of training, their allocation to the acquired type of knowledge, as well as examples and the presumed effect on turnover intention. We suggest that firm-specific training or internal development training mainly promotes non-portable knowledge, which cannot easily be transferred to other organizations (see for example: Bertolino et al. 2011; Green et al. 2000; Wingreen and Blanton 2018). However, general training such as business or IT training, and especially training with certifications, promotes portable knowledge, which can also be used in other organizations (see for example: Cha and Quan 2011; Joia and Mangia 2017). In the following, we will explain the different effects of non-portable and portable training on turnover intention in detail.

Type of knowledge	Examples for training	Description	Example	Effect on turnover intention
Non-portable knowledge	Firm-specific training	Training on the firm's systems, architecture or processes	Training for a software developed and used in-house	Decreasing (Wingreen and Blanton 2018)
	Internal development training	Training that communicates organizational culture and values to align employees	Training on the firm's vision	Decreasing (Sieben 2007)
Portable knowledge	Business training	Training on business-skills of various forms, such as presentation skills	Sales Training	Increasing (Joia and Mangia 2017)
	Project management training	Training on IT project management skills	Agile training	Increasing/neutral (Sieben 2007)
	IT training	Training on technical knowledge	Training on Java programming	Increasing/neutral (Sieben 2007)
	Certifications	Certifications in various, technical areas	CISSP – Certified Information Systems Security Professional	Increasing (Cha and Quan 2011)

Table 1. Types of Training

Non-portable Knowledge

Training which includes firm-specific knowledge, such as knowledge about internal processes and systems, is particularly important for organizations, since it can only be acquired in the company and cannot be brought along by professional experience (Slaughter et al. 2007). Employees acquire non-portable knowledge in the company for example through firm-specific training such as training on a software, which is developed and used in the company (Slaughter et al. 2007; Wingreen and Blanton 2018), or through internal development training, which makes them more adept at navigating organizational culture and values (Roepke et al. 2000).

Firm-specific knowledge helps increase the employee's fit with the organization. It leads to an increased match between the required skills of the employee and their capabilities (Slaughter et al. 2007; Wingreen and Blanton 2018) and increases the value of the employee for the company (Joseph et al. 2010). Furthermore, employees receiving firm-specific training are better able to cope with work tasks and challenges in the company (Joseph et al. 2011). Finally, internal development training is a clear sign that the company is willing to invest in the employee and reflects a form of appreciation (Sieben 2007). Since both firm-specific training and internal development training are non-portable knowledge, we hypothesize:

> *H1a: Receiving training, which fosters non-portable knowledge, decreases the turnover intention of IT professionals.*

Portable Knowledge

In contrast, training that develops knowledge, which is easily portable into other contexts and companies increases turnover intention. Business or project work related training foster knowledge that is not only applicable in the organization, in which it is obtained, but also in other organizations and even other professions. Thus, this kind of training promotes the market value of employees and makes them more attractive and valuable for other organizations (Joia and Mangia 2017; Slaughter et al. 2007).

The increasing effect of portable knowledge on turnover applies in particular to certifications. In the IT sector, certifications are a popular proof of the expertise of employees (Quan et al. 2007). Despite their popularity, certifications are a double-edged sword. On the one hand, organizations want to provide their employees with them, for example to certify their skills in front of customers, on the other hand, certifications represent a high degree of transferability and also provide official confirmation of knowledge (Cha and Quan 2011; Quan et al. 2007). Similar to business and project management training, the employee's market value increases, making the employee more marketable and easier to transfer to another company. Thus, we hypothesize:

> *H1b: Receiving training, which fosters portable knowledge, increases the turnover intention of IT professionals.*

Moderation Effects

In the last decades, commitment theory has become increasingly important to explain employee behavior and well-being (Meyer et al. 2013). This is not least due to the increasing complexity that commitment has reached. Whereas commitment used to be researched mostly one-dimensionally (Porter et al. 1974), it is now assumed to be a multiple-component construct, which can be directed to different directions (profession, team, leaders, family etc.) (Meyer and Herscovitch 2001). Two forms of commitment which are especially from interest are organizational and professional commitment. Organizational and professional commitment refer to the "relative strength of an individual's identification with and involvement" (Porter et al. 1974) in an organization or in a profession. The relations between organizational and professional commitment receive a lot of attention in the management literature, but have not yet been clarified (Meyer et al. 2013).

So far, IS researchers have thoroughly investigated organizational commitment, and have demonstrated its positive effects on job outcomes (see for example: Ahuja et al. 2007; Thatcher et al. 2002). However professional commitment is examined in the IS research rather rarely. Given the multifaceted nature of commitment, we aim to develop a better understanding of the differences between organizational and professional commitment. Following previous IS research on internal labor market strategy, we assume

that employees either are more loyal to their organization and thus progress along job ladders in the firm or are more loyal to the profession and thus also consider jobs outside of their organization to move up in the hierarchy (Ang and Slaughter 2004). Depending on the form of commitment, we suggest different effects on the relation between training and turnover intention, which we now explain in detail.

We suggest that IT employees with high voluntary organizational commitment, namely affective commitment, use training in their company to acquire the necessary skills to develop their career within their current organization. These employees experience a strong belongingness to their organization with lower intention to turnover (Meyer et al. 1993). Thus, we expect them to use organizational training as an opportunity to expand their knowledge to become more valuable for their current employer (Ang and Slaughter 2004), instead of focusing on gaining knowledge that makes them more valuable for other companies. We therefore hypothesize that organization oriented attitudes of employees increase the positive effects of training on turnover intention and reduce the negative ones.

H2: The relationship between training and turnover intention is moderated by organizational commitment such that it

a) increases the positive effect of training which fosters non-portable knowledge.
b) decreases the negative effect of training which fosters portable knowledge.

Contrary to the effect of organizational commitment, IT employees showing high professional commitment plan their careers independently from their current organization (Cho and Huang 2012). Those IT employees feel a strong sense of calling to their profession and are willing to put effort into succeeding in their profession (Dinger et al. 2015). Thus, we suggest that employees with high professional commitment will use the training offered in the company to acquire the necessary knowledge for ensuring professional success, independently from their current employment. These employees experience participation in training serves as a means to expand their skills and become more marketable (Ang and Slaughter 2004). We therefore hypothesize that profession oriented attitudes of employees increase the negative effects of training on turnover intention and reduce the positive ones.

H3: The relationship between training and turnover intention is moderated by professional commitment such that it

a) decreases the positive effect of training which fosters non-portable knowledge.
b) increases the negative effect of training which fosters portable knowledge.

Next Steps

We will test our model using data from IT companies based in Germany and the United States. For this purpose, we have created a questionnaire that contains the constructs found in our model. We have adapted established scales from psychology, human resources and IS literature (see Table 2).

We will select the companies based on their similar characteristics of number of employees, core competencies, and business strategies. We will target IT professionals who play roles of IS development (eg. software developer, IT project manager). The questionnaire will be sent to 1000 IT professionals across these companies. We expect a response rate of approx. 30%, which corresponds to a sample size of n=300 and thus meets the minimum requirements for significant results, which is n=89 (G*Power: Linear multiple regression, tail(s): 2, effect size f2 = 0.15, α err prob: 0.05, power (1-β err prob): 0.95, number of predictors 5). We plan to use multivariate regression analysis to test our model (Hair et al. 2014).

Type	Construct	Source	Example
Independent Variables	Training (Type & Amount)	-	Please indicate what type of training, as well as how much training you have completed in the last 3/6/12 months: - Firm-specific training: Y/N + number of trainings
Moderators	Organizational Commitment	(Meyer and Allen 1991)	I feel a 'strong' sense of belonging to my organization.
	Professional Commitment	(Meyer et al. 1993)	My profession has a great deal of personal meaning for me.
Outcome	Turnover Intention	(Ahuja et al. 2007)	I will probably look for a job at a different company in the next year.

Table 2. Survey Design

Conclusion

Our study will shed light on the training paradox of IT professionals. We expect varying impact of training on turnover based on the type of knowledge acquired, which will be moderated by two different forms of commitment: organizational and professional. Our study will help to explain whether and to what extent different forms of commitment influence IT professionals' response to training in their organizations. First, our study will shed light on whether organizational commitment mitigates the effects of building IT professional's portable knowledge on turnover intention. Such understanding is important, because an extensive HR literature directs attention to levers that increase employees' commitment to their employing organization. Second, our study will help to explain how employees' professional commitment may magnify the negative effects of portable training on turnover and decreases the positive effects of non-portable training on turnover. Such understanding is important, because it provides a clearer picture of the implications of providing training to IT professionals.

Our study contributes to three IS research streams. First, we apply paradox theory as a theoretical lens and demonstrate the utility of paradox theory for IT workforce research. While following predecessors in the IS research field who have used paradox theory to explain phenomena in their field of research (Awad and Krishnan 2006; Brooks et al. 2020; Carlo et al. 2012), we aim at providing rich practical implications by shedding light on the training paradox of IT professionals.

Second, we directly test the training paradox of IT professionals. We suggest different types of training and investigate their effect on the turnover intention of IT professionals. We follow research in the IS context, which deals with training of IT (Ferratt et al. 2012; Joia and Mangia 2017; Joseph et al. 2011; Slaughter et al. 2007) and expand their findings. To our best knowledge, we are the first to investigate the different types of training in the IT context in this detail. Beyond that we provide new knowledge by assigning different kind of trainings in IT to their portability of acquired knowledge and thus testing the training paradox. Through a detailed study of different types of training, we aim to expand the existing literature and build a profound knowledge of the varying impact of training on turnover intention.

Third, we directly test the paradox of the commitment in the IT profession, whereby individuals juggle competing loyalty towards their organization and their profession. We are particularly interested in investigating whether and to what extent organizational and professional commitment differ. We thus propose a path to address the negative effects of training on turnover intention and strengthen the positive effects based on the investigation of different orientations of employees. We expand research on organizational and professional commitment of IT professionals, which so far has been primarily concerned with commitment's direct effect on turnover or turnaway (see for example: Armstrong et al. 2015; Thatcher et al. 2002). With our research, we broaden understanding of the effects of organizational and professional commitment on the experience of IT professionals and their response to their employing organizations.

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RESEARCH ESSAY

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When your data has COVID-19: how the changing context disrupts data collection and what to do about it

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ABSTRACT

Global crises, such as the COVID-19 pandemic, change the context for research and bring with them many professional challenges for IS researchers – not the least of which is disrupting carefully thought-out data collection efforts. In this confessional tale, we describe how moving from an "open research ecosystem" to a "socially distanced research ecosystem" has affected a long-planned data collection effort. While government orders to socially distance and physically isolate may have made the world "stand still" for some, we found that these orders had dynamic and consequential effects for our in-process research. Against the backdrop of significant threats posed by the contextual change to our data collection, we explain how the crisis also opened up opportunities to invigorate our understanding of how the environment affects how we conduct research. We conclude our tale with guidelines for how to successfully respond when your research is interrupted by a change of context.

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1. Introduction

Within a very short time, COVID-19 has become a defining feature of daily life on every continent. The pandemic has resulted in government admonishments to stay home and the implementation of necessary restrictions to maintain the integrity of health care systems in many countries. It has also introduced substantial economic uncertainty, with the World Bank suggesting as much as a 5.2 percent contraction in the global gross domestic product (The World Bank, 2020). As we write this, it is unclear when the pandemic will end; indeed, we are hard pressed to predict the long-term consequences of the lockdown caused by COVID-19 for individuals' private and professional lives, or for that matter, for broader societies and economies (Baker et al., 2020).

COVID-19 has touched people's public life, work life, and private life, making it urgent to look at the effects of the pandemic from different perspectives. This urgency is felt across many fields of research, with leading journals like Nature and associations like the APA calling for the investigation of the effects of the disease and its impact on people across the world (American Psychological Association, 2020; Nature, 2020). This urgency has led to numerous, rapid academic publications concerning the disease and its effects on people in various fields of research such as medicine, economics, psychology, and management (Chen et al., 2020; Sohrabi et al., 2020; Wang et al., 2020).

Like many academics and citizen scientists, IS scholars have stepped up to study COVID-19 and related social and economic challenges (see for example, Laato et al. (2020), Nabity-Grover et al. (2020), and Waizenegger et al. (2020)). Such responses are consistent with our discipline's tradition of active engagement with real-world problems (Forster & Tang, 2005; Leidner et al., 2009), such as preparing for the Year 2000 (Zmud & Kappelman, 1997), understanding the dotcom bubble in 2002 (Howcroft, 2001; Panko, 2008; Weber, 2004), or reflecting on how innovation sparked by the 2009–2012 financial crises resulted in technologies and markets that can respond to difficult, dynamic problems (Gozman & Currie, 2014; Wolf et al., 2012).

While it appears that times of crises create opportunities for IS researchers to not only help the world, but also to think more deeply about how sociotechnical systems shape the world around us, the pandemic clearly illustrates that researchers should consider how change of context could disrupt planned or ongoing studies. Thus, in this paper, we use our experience conducting research during the COVID-19 pandemic as a backdrop to investigate *How do we conduct rigorous, relevant research in the field against the backdrop of changing context?*

While the pandemic made the changed context easily noticeable, our experience suggests that researchers should be aware not only of abrupt changes in the context, but also of gradual changes

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that might not be recognisable at first glance. Abrupt or gradual changes in the technology context, such as artificial intelligence, might shift firms' IT strategies as easily as changes in the legal context, such as new data protection laws, might shift the relationship between trust and use of technologies by end users.

The question of how changing context affects research is especially important right now, because we are witnessing a massive disruption in how people live and work, with rapid, IT-enabled transitions from working in an office to working at home. While it is gratifying to witness the resilience of our sociotechnical systems, the speed and the surprise with which this disruption emerged is at odds with our careful, methodical IS research tradition. Noticeably absent is mindful reflection on what this disruption means for our ability to make inferences based on our observations of rapidly changing sociotechnical systems, and our scholarship risks missing opportunities that help us better understand how to manage IT and the people who interact with them.

In this paper, we present a confessional tale that uses our experience as scholars to glean insight into how to conduct rigorous, relevant IS scholarship during a crisis which substantially affects people's life and the economic conditions of countries all over the world, such as COVID-19. We present the impact of contextual changes on our ongoing study of the IT workforce. Since IT professionals, like many other professions, were significantly affected by the lockdown due to COVID-19, we think that this context serves as an excellent example of the impact of the pandemic on IS research. We tell the story of how the pandemic unfolded, the unexpected disruptions in where people worked, a broader pattern of environmental fissures in how we work, and the systematic disruption of our team's carefully planned research project. We extract lessons from our experience relevant to not only IS researchers seeking to study the implication of COVID-19, but also for researchers seeking to sustain their existing research agendas during times of contextual change.

Our tale unfolds in four acts. We begin with a Prologue, where we concisely review what is known about changing contexts and research. Then, we turn to Act One, which describes the process through which we carefully planned our study. Act Two provides more granular detail on how our research design and the pandemic jointly impacted our data collection effort. Act Three analyzes the data as a means to illustrate how the pandemic's early stages affected our participants' responses. Act Four reports lessons learned and implications for researchers – be they academic or citizen scientists – seeking to conduct data collection against the backdrop of contextual change.

2. Prologue: contextual change and research

Paying attention to the context, namely the "stimuli and phenomena that surround and thus exist in the environment external to the individual (Mowday & Sutton, 1993)" and reporting its impact is a classic concept in social science research (Bamberger, 2008; Johns, 2006). Whether it is research at the organisational (Rousseau & Fried, 2001), group, or individual level (Mowday & Sutton, 1993), we are all trained to think about the context within which we conduct research and its implications for how we interpret and draw boundaries around our findings. In IS research, attention to the sociotechnical context has been a recurring theme (Davison & Martinsons, 2016) shaping the fundamental discourse of our discipline, contributing to its distinctiveness and, consequently also shaping its legitimacy (Sarker et al., 2019).

Several studies underscore the importance of context and its relationship to generalisability in IS research. Our literature is rich in papers that provide guidelines for contextual theory development (Hong et al., 2013; Siponen & Vance, 2014), robust data collection (Steelman et al., 2014), and for measurement of data quality (Timmerman & Bronselaer, 2019). For those interested in theory, Hong et al. (2013) provide guidance on how to contextualise established theories or replicate models in different contexts. For those interested in testing theory, Siponen and Vance (2014) introduce recommendations on how to contextualise survey instruments in IS research. A growing body of work provides insight into the implications of context for how we gather and assess data. For example, Steelman et al. (2014) have evaluated data collection in online crowdsourcing markets and find differences based on the geographical context. Building on such insight, Timmerman and Bronselaer (2019) describe how to measure the data quality in IS studies and suggest a framework which considers what, when, where, how, by whom, which, and why data were collected to assess data quality.

While mention of the context receives a significant amount of attention in IS research, little of the literature details the implications of changes of context for data collection and study design, such as for the quality of data collected or the generalisability of findings (Onwuegbuzie & McLean, 2003). We know that contamination from the environment and noise in the data threatens generalisability of studies and their presence requires robustness checks to understand their implications (see for example, Park et al. (2012)). Suggesting that understanding the implications of changes in context are important because of generalisability or external validity is important for quantitative as well as qualitative IS research (Seddon & Scheepers, 2012), and under-appreciating

implications of changes in context might place generalisability of findings at risk (Cook & Campbell, 1979). Therefore, we think it is useful to consider how contextual change both affects the data we gather and contributes to the understanding that we glean from it, without suggesting that it must necessarily undermine the validity of our findings.

Against this backdrop of concern about context, external validity, and replication in IS research, we are not aware of any study that provides guidance on how to cope with change of context's implications for data collection, study design, and insights derived from it in IS studies. We turn to our confessional tale that illustrates how COVID-19 changed the context of our data collection in order to elicit broader guidance for how IS researchers can cope with and plan for the influence of unexpected change in the context of their research.

3. Act one: planning our study

Our study was meant to be normal science. In the summer of 2019, our team met to plan a study that examined how training affects the career mobility of IT professionals. Over the next eight months, we defined a research question, built a model that differentiated the effects of different types of training on the motivation, commitment, and behaviour of IT professionals, developed a contextualised set of measures, and recruited several firms to participate in our study. This process was slow and iterative, with members of our research team meeting face to face four times with numerous Skype calls in between, conducting in-person and technology-mediated interviews with industry representatives, completing multiple iterations of construct measures, and soliciting peer review of our model and research design. Slowly and steadily, we built a study that we felt was relevant to the industry and would yield high impact findings. Figure 1 provides an overview of the research design process.

In January 2020, as the pandemic slowly gained momentum in China, our team met in Germany to finalise the design and prepare to launch the data collection. We interviewed a high-level executive who confirmed the practical relevance of our work, met with an IT representative involved in training to jointly complete the design of our questionnaire, and floated a copy of our questionnaire by union representatives. Such care was necessary to properly sample the domain of IT training as well as to capture relevant training outcomes from the point of view of practicing IT professionals and their managers.

In early February, as the first COVID-19 cases were reported in Europe, we planned our study's launch. Our questionnaire was reviewed and approved by an employee committee and by the corresponding management team. We further fine-tuned the questionnaire, so that it contained interesting aspects for research as well as for practice. As we made minor modifications to further take into account industry feedback, we scheduled data collection to span from late February to April.

In mid-February, as news broke that COVID-19 might be more problematic than expected, we finalised the launch of the data collection. We placed our survey online and pretested it. Our organisational colleagues provided upbeat reports of continued organisational support and their enthusiasm for the project.

In late-February, we felt great as data rolled in, because we had ticked all of the prescriptive boxes

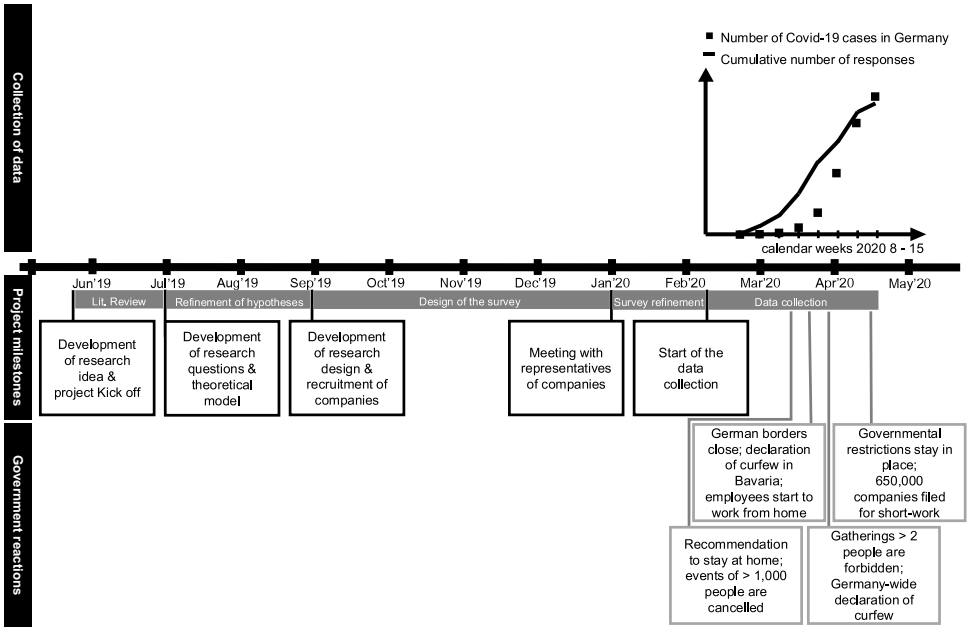

Figure 1. Process of research study.

found in the research design and the IT workforce literature. Our design was methodical, contextualised, and rigorous. What could go wrong?

In May – as we reflect back on the past four months – we realise that we were naïve: in our careful research design we had not anticipated the effects of COVID-19 on our work. As data collection progressed, governments tightened rules for citizen behaviour, workplaces changed, and our respondents moved from time spent in the office with colleagues to time spent at home with partners and children. Soon we realised that while our questionnaire was sound; however, the context for data collection was changing from week to week, making the outcomes of our study unpredictable for us as researchers, but more importantly, capturing the influence of economic uncertainty due to COVID-19 on employees' perception of their job and employers.

4. Act two: collecting data as the pandemic breaks

Our study was intended to follow current calls for research on the IT profession (Wiesche et al., 2019) and sought to explore the IT training paradox to understand why different forms of training bound some IT professionals to the firm and pushed others away. Our questionnaire included relevant scales from Psychology and Human Resources and IS studies. Extracts from the questionnaire can be found in Table 1.

Our design maximised the chances of capturing a representative sample. We adhered to Dillman's prescriptions, taking time to notify participants that we were sending a survey, with multiple interim reminders, and a final invitation to participate (Dillman et al., 2014). The questionnaire was scheduled to be available online for about 10 weeks, from mid-February to the end of April. To increase generalisability, we took care to collect data from seven firms active in the German IT sector.

COVID-19 radically disrupted our design by altering the context for data collection. When we distributed the first wave of questionnaires to participants, there was still little sign of the – at that time not yet officially announced – pandemic in Germany, where the survey was conducted. Although we suspected that COVID-19 might be dangerous, because one team member had recently visited China, we did not foresee how seriously the governmental responses to COVID-19 would impact our data collection. Table 2 maps the progression of COVID-19 in Germany to our data collection.

During the last week of February, we distributed the first wave of questionnaires and received 14 responses. At the beginning of the survey there were 16 COVID-19 cases in Germany (Robert Koch Institut, 2020c). There were no government restrictions announced, but the crisis committee in Germany was convened (The Federal Governmant of Germany, 2020b).

In the beginning of the second week, the number of infected people had risen to 150 cases in Germany, still there were no restrictions, and the risk assessment of COVID-19 for Germany was announced as moderate (The Federal Governmant of Germany, 2020a). However, Italy was declared as one of the first official risk areas due to their high number of infected cases (Robert Koch Institut, 2020a). We collected 22 responses in this week.

By mid-March, the number of infected people in Germany rose to 4,838 cases. The first restrictions in Germany were announced, for example, events with more than 1,000 participants were cancelled (The Federal Governmant of Germany, 2020c). The German government recommended staying at home when possible. The economy was not affected at that

Table 1. Survey design.

Construct	Source	Example
Training (Type & Amount)	-	Please indicate what type of training, as well as how much training you have completed in the last 3/6/12 months: - Business training Y/N + number of trainings - Project management training Y/N + number of trainings - Firm-specific training Y/N + number of trainings - Leadership training Y/N + number of trainings - IT training Y/N + number of trainings - Certifications Y/N + number of trainings - Private training Y/N + number of trainings
Affective Commitment	(Allen & Meyer, 1990)	I feel a 'strong' sense of belonging to my organisation.
Person-Organisation Fit	(Venkatesh et al., 2017)	I fit right into my current organisation.
Job Satisfaction	(Tripp et al., 2016)	Overall, I am satisfied with my job.
Perceived Job Alternatives	(Weng et al., 2010)	It would be easy for me to find a new job after leaving this organisation.
Professional Commitment	(Meyer et al., 1993)	My profession has a great deal of personal meaning for me (adapted).
Professional Ambition	(Rothwell et al., 2008)	I have clear goals for what I want to achieve in life.
Turnover Intention	(Moore, 2000)	I will probably look for a job at a different company in the next year.

Table 2. Data collection while COVID-19 unfolds.

Week of survey	Dates	Confirmed COVID-19 Cases in Germany	Government responses	Collected responses in study
1	24.02. – 01.03.	16–117	• No governmental restrictions for population • Germany opens assembly of experts • Unemployment rate: 5.3 %	14
2	02.03. – 08.03.	150–847	• No governmental restrictions for population • Risk assessment of COVID-19 for Germany: moderate • Official announcement of Italy as a risk area	22
3	09.03. – 15.03.	1,112–4,838	• Recommendation to stay at home when possible • Events of over 1,000 people are cancelled • Official announcement of risk areas around Germany (e.g., Italy, Austria, France) • Unemployment rate 5.1 % (−0.2)	44
4	16.03. – 22.03.	6,012–18,610	• All German borders get closed; • Risk assessment of COVID-19: high • Declaration of curfew in Bavaria; • Most of companies announce that their staff is recommended to work from home	63
5	23.03. – 29.03.	22,672–52,547	• Government forbids gatherings of more than 2 people • Declaration of curfew in further German states • 470,000 German companies filed for "short-time work"	32
6	30.03. – 05.04.	57,298–91,714	• Governmental restrictions stay in place • Obligation to wear masks in some German cities • 650,000 German companies filed for "short-time work" • Unemployment rate 5.8 % (+0.7)	67
7	06.04. – 13.04.	95,391–123,016	• Governmental restrictions stay in place • 14 day quarantine for homecoming Germans	9

time, and the unemployment rate even dropped a little (Federal Employment Agency of Germany, 2020b). Employees were still working from the office. We collected 44 responses in this week.

From Week 4 on, the effects of COVID-19 noticeably impacted the lives of normal employees. The risk assessment of COVID-19 for Germany was changed to "high" (Robert Koch Institut, 2020b). Companies directed employees to work from home. Our research team also moved our work to our homes. Beyond that, the German borders got closed and Bavaria (where the study was primarily located) declared a curfew (Bayerische Staatsregierung, 2020). One author cancelled plans to attend face-to-face meetings in Germany. In this week we collected 63 responses.

The effects of COVID-19 on professional life and on the job market in Germany became pronounced from Week 5 and 6 of our study. The number of infected persons was increasing rapidly. Germany allowed companies to announce "short-time work,"[1] of which approximately 650,000 companies in Germany were making extensive use at the end of Week 6 of our study (Federal Employment Agency of Germany, 2020c). For the most part, the economy was at a standstill, and gatherings of more than two people were prohibited. The unemployment rate increased by 0.7 percent within a very short time (Federal Employment Agency of Germany, 2020a). Planning for companies, as well as their employees, was difficult at this time because the current situation could not be controlled and the future prospects were uncertain. In Week 5 and 6 we collected 99 answers.

Week 7 was characterised by continuing restrictions. However, solidarity and habit spread among the population. The increase in the number of infected people was still rising, but not as strongly as in the few weeks prior to Week 7. Employees continued to work from home. The economic consequences for companies and the population of Germany were becoming more pronounced. In this week we collected 9 responses.

Since responses had stopped trickling in, we stopped collecting data. In total we had received 251 complete answers in the 7 weeks.

5. Act three: isolating the effects of the pandemic

While we knew the pandemic's impact on the economy presented challenges to data collection, we were less certain that it disrupted the nomological net that predicted IT professional's behaviour. So we tested established relations related to training and turnover in the IT workforce literature (Ferratt et al., 2005). Nothing worked. Relationships between training and career mobility that IT workforce research work had verified time and time again were not significant (Ferratt et al., 2005; Quan & Cha, 2010; Wingreen & Blanton, 2018). These results were exceptional and disappointing. While we expected the uncertain economic situation due to the pandemic to influence our data collection, we had not expected it to disrupt the baseline set of relationships that formed a conceptual foundation of our model.

This initial analysis made us take a step back, and consider whether we could isolate the impact of the pandemic in our sample of IT professionals. We executed four sets of analysis that tested the influence of the time stamp of the collected answers on the dependent variables. First, we defined the weeks as a progressive, dummy variable and added it to our structural equation model to examine its effect on different dependent variables, such as turnover intention, affective commitment, person-organisation fit and job satisfaction, or perceived job alternatives. We saw that the dummy variable significantly influenced turnover intention (β: −0.178; $p < 0.001$), as well as affective commitment (β: 0.176; $p < 0.001$), and person-organisation fit (β: 0.134; $p < 0.05$). This means that while turnover intention decreased significantly in the weeks studied, affective commitment and person-organisation fit significantly increased. This is not surprising, as the job market outlook in Germany became poorer and more uncertain as the pandemic progressed (Federal Ministry for Economic Affairs and Energy in Germany, 2020).

We then conducted a wave analysis to understand the impact of the rapid economic change caused by COVID-19 on our questionnaire. We divided the data set into two parts to compare responses at the beginning of the COVID-19 crisis with responses later on in the pandemic. We divided answers that we received in Weeks 1, 2, and 3 into the pre-crisis period (n = 80) and answers in Weeks 5 and 6 into the crisis period (n = 99). To test for differences between these time periods, we used non-parametric tests (Mann-Whitney Test), since our data did not have a normal distribution (see Table 6 in the appendix for the descriptive statistics).

We analysed data at the item level and the construct level. The results revealed that responses before the crises differed significantly from responses during the crises for the following constructs: turnover intention, affective commitment, person-organisation fit, and professional commitment. We found that withdrawal cognitions decreased and people felt greater commitment to the organisation and fit with their jobs. While turnover intention decreased significantly (mean 1st wave: 3.28, mean 2nd wave: 2.59, difference: −0.69, $p < 0.01$), affective commitment (mean 1st wave: 5.03, mean 2nd wave: 5.53, difference: +0.50, $p < 0.05$), and person-organisation fit increased significantly (mean 1st wave: 4.94, mean 2nd wave: 5.36, difference +0.42, $p < 0.05$). We also found a positive, significant increase for professional commitment (mean 1st wave: 5.23, mean 2nd wave: 5.62, difference: +0.39, $p < 0.05$). There was no significant change for the variables perceived job alternatives, job satisfaction, and professional ambition. Table 3 summarises the results.

The change between the two waves also became clear when we looked at the chronological sequence of the answers. Figure 2 shows the decrease in turnover intention over the course of the study. The plotted question is "*How likely is it that you will take steps during the next year to secure a job at a different company?*" Figure 3 shows the increase in affective commitment over the course of the study. The plotted question is "*I enjoy discussing my organization with people outside it.*"

Finally, we calculated our theoretical model separately for the two waves and performed a multi-group analysis using SmartPLS (see details in Appendix A). The results revealed differences in the influence of training on affective commitment, job satisfaction, person-organisation fit, and professional ambition. While we found significant influence of training on these variables for the first group, the second group did not show significant effects of training on any variable. Also, established relationships worked with wave 1, which did not work with wave 2 (see for example: job satisfaction -> turnover intention

Table 3. Differences in responses before and during the pandemic.

Constructs	1st wave Mean (SD)	2nd wave Mean (SD)	Difference	U	Z	P-value
Turnover Intention	3.28 (1.71)	2.59 (1.70)	**−0.69****	2890	−2.193	**0.004**
Affective Commitment	5.03 (1.55)	5.53 (1.45)	**+0.50***	2955	−2.401	**0.016**
Person-Organisation Fit	4.94 (1.46)	5.36 (1.38)	**+0.42***	3184	−2.043	**0.041**
Professional Commitment	5.23 (1.23)	5.62 (1.16)	**+0.39***	3235	−2.137	**0.033**
Perceived Job Alternatives	5.34 (1.34)	5.45 (1.34)	+0.11	3506	−0.975	0.330
Job Satisfaction	5.37 (1.08)	5.41 (1.36)	+0.05	3519	−1.077	0.281
Professional Ambition	5.59 (0.85)	5.64 (0.76)	+0.05	3831	−0.377	0.706

Significant codes p-value: **: <0.01, *: <0.05

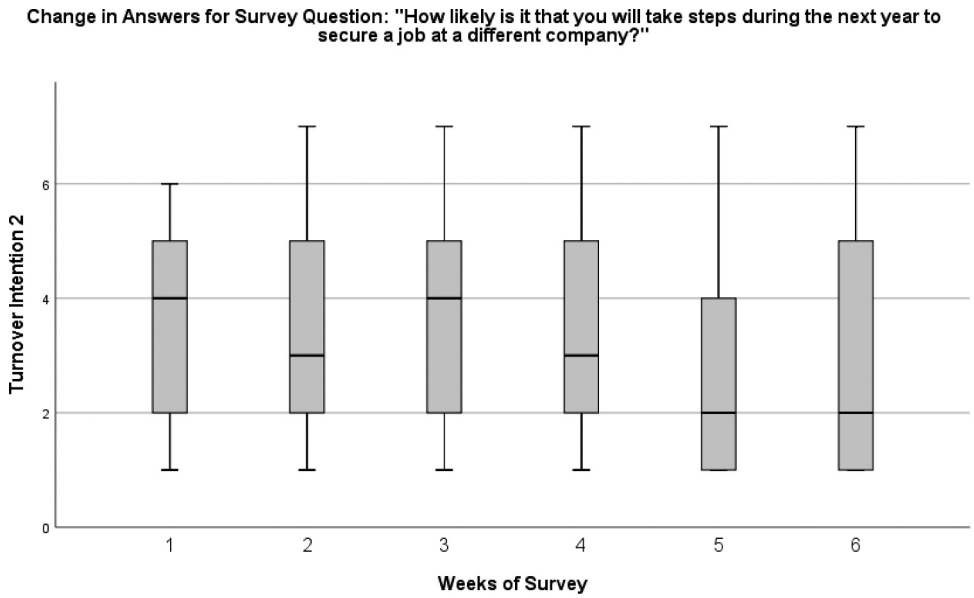

Figure 2. Change in turnover intention.

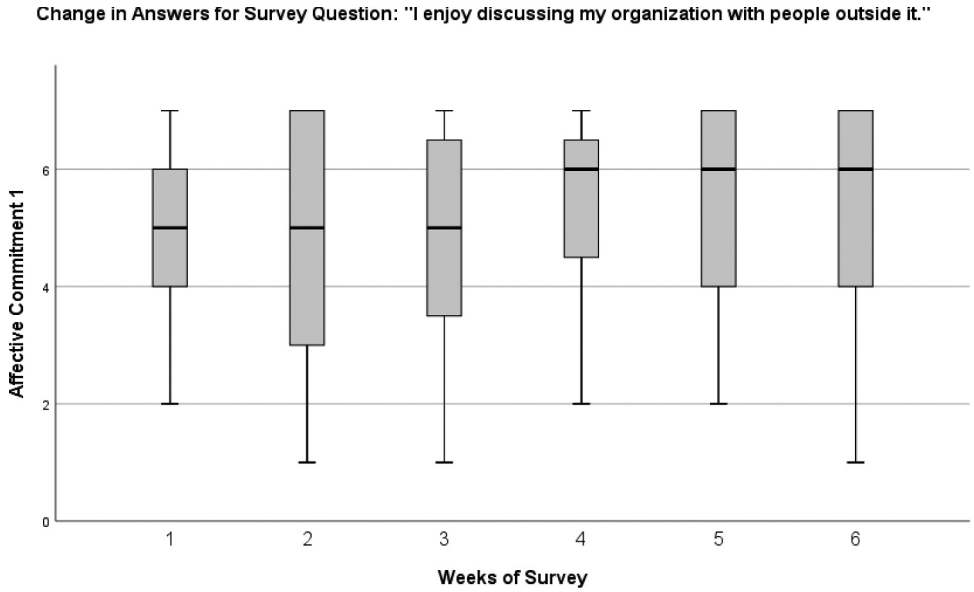

Figure 3. Change in affective commitment.

(β = −.468, p < 0.05) or professional ambition − > turnover intention (β = 0.381, p < 0.05)). These results indicate that wave 2 is influenced by the contextual change and the economic consequences of COVID-19. Table 4 provides an overview of the results. Figures 4–6 show the differences of the waves graphically.

5.1. Changes in context and our findings

The data show how the COVID-19 pandemic influenced our respondents' perception and intentions. First, we observed a significant decrease of turnover intention. Due to high economic uncertainty on the job market, organisations paused planned hires, forcing employees to put their career decisions on hold (Chinn et al., 2020). Consequently, our respondents responded to the shifting labour market by becoming less willing to quit as the pandemic unfolded. Second, we observed a significant increase in affective commitment and person-organisation fit. We attribute this increase to the generous responses from companies due to the current situation around COVID-19. For example, two companies announced that employees with families would be given more flexibility. Third, we observed a significant increase in professional commitment. We suggest that this increase is due to the comparatively easy switch to working from home in IT and the job security that the IT profession brings with it even in times of crises. Due to the nature of IT, IT work often can be carried out independent of its place of execution (Sarker et al., 2011, 2018). Compared to other professions, this makes IT work less sensitive to the sudden shift to remote working resulting from the crisis.

Table 4. Structural equation modelling for both waves and in total.

Paths in Structural Equation Model	Path Coefficients 1st wave	P-value 1st wave	Path Coefficients 2nd wave	P-value 2nd wave	Path Coefficients total	P-value total
Training 6 Months -> Affective Commitment	**0.317***	**0.010**	0.045	0.683	**0.208***	**0.011**
Training 6 Months -> Job Satisfaction	**0.373****	**0.000**	−0.031	0.751	0.145	0.063
Training 6 Months -> Professional Ambition	**0.282***	**0.015**	0.003	0.988	0.185	0.056
Training 6 Months -> Perc. Job Alternatives	0.120	0.417	0.121	0.378	0.046	0.574
Training 6 Months -> Person Org. Fit	**0.273***	**0.014**	0.060	0.551	**0.193***	**0.012**
Training 6 Months -> Prof. Commitment	0.053	0.747	0.023	0.845	0.065	0.476
Training 6 Months -> Turnover Intention	−0.047	0.653	−0.036	0.627	−0.062	0.268
Aff. Commitment -> Turnover Intention	**−0.309***	**0.045**	**−0.520****	**0.001**	**−0.430****	**0.000**
Job Satisfaction -> Turnover Intention	**−0.468***	**0.014**	−0.145	0.193	−0.184	0.073
Professional Ambition -> Turnover Intention	**0.381***	**0.025**	0.016	0.865	0.136	0.119
Perc. Job Alternatives -> Turnover Intention	−0.012	0.918	0.142	0.118	0.102	0.175
Person Org. Fit -> Turnover Intention	−0.090	0.652	−0.072	0.659	−0.126	0.340
Prof. Commitment -> Turnover Intention	0.025	0.822	−0.063	0.577	−0.046	0.536

Significant codes p-value: **: <0.01 *: <0.05

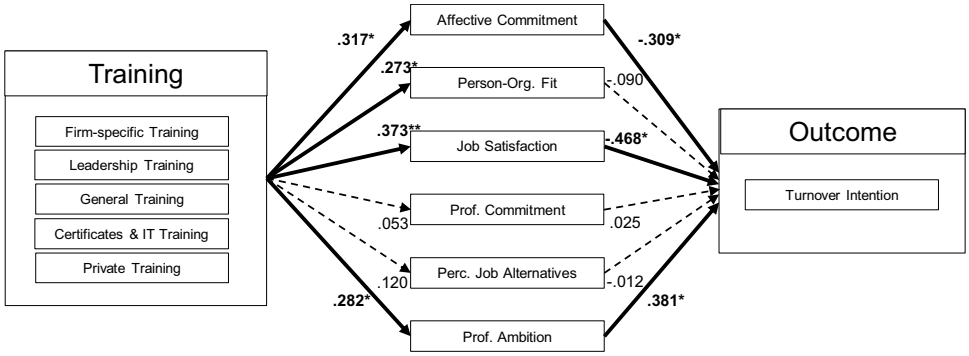

Figure 4. Results of structural equation model – 1st wave.

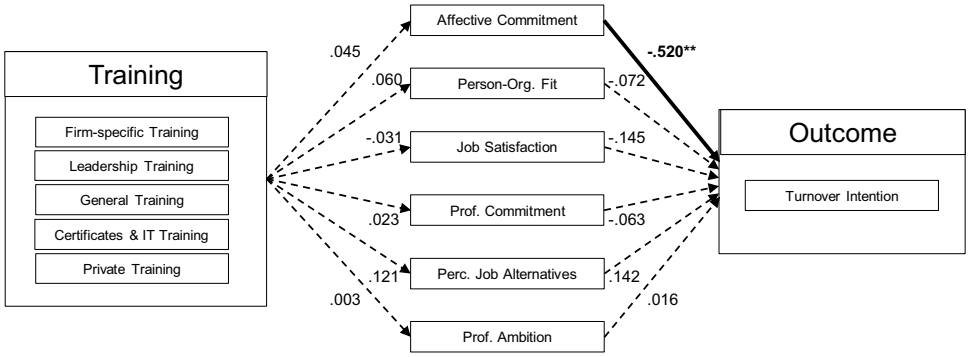

Figure 5. Results of structural equation model – 2nd wave.

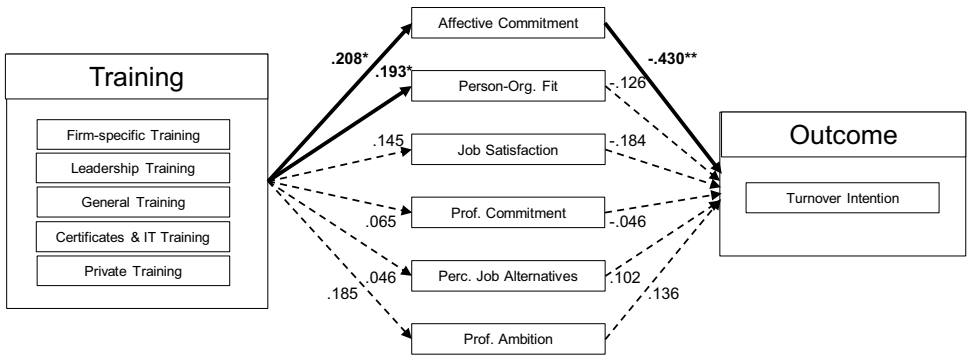

Figure 6. Results of structural equation model – total.

The contextual changes due to the pandemic had the consequence that our analysis of the second wave data did not support established relationships. While in the first wave data, our model of the influence of training on affective commitment, person-organisation fit, and job satisfaction was supported, this relationship disappeared completely in the second model. The antecedents to turnover intention also changed. While in the first model affective commitment, job satisfaction, and professional ambition significantly influenced turnover intention, in the second wave we could only find a strong influence of affective commitment on turnover intention. Even one of the most established triggers for turnover intention, job satisfaction (Joseph et al., 2007), was not significant in the second model. These changes illustrate how the change in context, evoked by the pandemic, impacted not only our data collection but also a well-established nomological net of relationships. In the following pages, we provide recommendations on how to respond when research is interrupted by contextual change.

6. Act four: caution and curiosity

So what to do? Our relatively simple analysis showed that data collected during times of contextual change could be severely contaminated by external environmental influences. By dividing our data into pre-pandemic and pandemic samples and then running analysis of different models, we were able to identify significant differences not only in the responses, but also in well-established sets of relationships. In the following, we draw on examples of the impact of the uncertain situation due to COVID-19 to inform recommendations on how to address issues that arise from collecting data during contextual change.

6.1. Conducting research in times of changing context

Many researchers, like ourselves, are likely asking themselves to what extent they can conduct their research against a backdrop of an evolving context. This is a challenging question, particularly because most research takes place over months or even years. On the one hand, it is normal for broader economic conditions to impact data collection. For example, during a recession, one would expect respondents to be generally less optimistic. On the other hand, the severity and reach of some current events far exceed what is normal, requiring that researchers employ a certain degree of caution when it comes to drawing inferences from data. Thus, we provide recommendations for those preparing to design studies and engage in data collection (prospective steps), conduct data analysis with data that might be affected by contextual change (retrospective steps), as well as post-hoc steps (supplementary steps), which help to evaluate how changing context impacts findings. Table 5 provides an overview of the guidelines.

6.2. Prospective steps

For researchers starting a new study which might be affected by contextual change, we recommend to consider three additional steps in their research process:

6.2.1. Step 1 – Ground your study in theory, because theory still matters

Theory building and application represent the backbone of rigorous IS research. Even if the current contextual changes caused by the pandemic represent major disruptions and might imply that theories cannot be applied as they usually are, theory should still form the basis of rigorous research and should not be neglected in times of strong contextual change. We even argue that theory is especially important in times of contextual change, since it provides a profound framework in times of high uncertainty, as well as empirical evidence on the validity of the theory across contexts. Instead of opting not to ground studies in theories, we should rather ask ourselves to what extent theories can be used to study current developments. Thus, we recommend that established theories should first be considered as the basis for research, and where possible, expanded or modified to consider contextual change. The next steps illustrate more clearly how such a modification can take place.

At this point we want to draw your attention to contextual change that is so severe that it leads to theories which can no longer be applied and thus causes a complete shift of the theoretical lens. After reviewing the theory in detail and checking for its feasibility, you may find that the phenomenon you wish to investigate is so radically affected by contextual change that it requires reconceptualisation and reframing of the study (please see the chapter on Radical Contextual Change and Theory Change). In such situations, researchers should critically ask – does this present an opportunity for theory construction? Or establishing new boundaries on existing theory? In either scenario, we recommend that authors faithfully report the impact of radical contextual change on their study. Such reporting is particularly important in the research method, in the discussion of the results, and in the limitations of the paper, because context will shape how readers interpret the results of your study. Even though we often tend to associate limitations as articulating weaknesses of a study, we suggest authors note that a radical contextual change occurred and explain how it afforded an opportunity to investigate questions and conditions that otherwise would not have been possible. If well done, such a limitation underscores the strengths of your work.

Table 5. Guidelines for conducting research while considering changing context.

Traditional Research Process	Additional Steps To Consider Contextual Change	Example
Prospective Steps		
Study Design	**Step 1 – Ground your study in theory, because theory still matters** Don't neglect theory. Explore whether the theoretical foundation of the study can be applied due to contextual change. First, consider potential changes to your model, within the constraints of established theories, to be consistent with current developments. Second, if this is not possible, cast about for a new theory to frame your study. Third, if you cannot find a theory that maps to your context and data, consider the changes an opportunity for constructing a new theory or testing the boundaries of existing theory.	• Consider additional constructs in your model to adapt your theory to current circumstances. For example, add "remote work" and "supervision of children" as additional constructs for capturing job demands during COVID-19.
	Step 2 – Head your data collection by taking the context into account • *Step 2a – Consider context that might change* When designing your study, consider contextual change from social, regulatory, economic, and technological disruptions, which impact expectations and behaviour of individuals. • *Step 2b – Consider how the data might be context sensitive* Pay special attention to your constructs and evaluate to which extent they are context sensitive. Examine context sensitivity not only on the construct level, but also on the item level. Add items to take into account changes. • *Step 2 c – Include context-specific control variables* Collect variables which pay attention to the context as a control to capture "noise" in the beliefs and perceptions of individuals.	• Look for incidents related to disruptions that reflect the ball of contextual change or signal contextual change in progress • Add additional items to your survey • Collect control variables for emotional state to control for challenging surroundings: e.g., negative affectivity (Moore, 2000), anxiety (Thatcher & Perrewe, 2002), or technostress (Califf et al., 2020)
Data Collection	**Step 3 – Document the data collection process to consider contextual change** Record the data collection process as accurately as possible to assess the influence of contextual change. Look for striking events during data collection that can affect the perception and beliefs of respondents. Consider collecting social media posts that capture the sentiment felt by members of your sample frame.	• Note remarkable events (Announcements in firm, government restrictions, etc.) and economic developments (stock prices, unemployment rate, etc.) which might evoke feelings of uncertainty
Retrospective Steps		
Measurement Validation & Hypotheses Testing	**Step 4 – Check your data for contextual change** Investigate whether the data collected is affected by external influences by looking for unusual values or changes in the data which might be a consequence of contextual change.	• Check for unusual values in your descriptive statistics (e.g., means, distribution, skewness, missing values) • Test your initial model and check for unexpected results
	Step 5 – Conduct robustness checks for contextual change • *Step 5a – Isolate the influence* Identify which constructs in the model are affected by delimiting the influence. Split the data sample based on time and respondent demographics and detect differences between subsamples. Compare your results with previous research. • *Step 5b – Control for the influence* Integrate control variables which reflect contextual shifts during data collection. Next to collected control variables in the survey, also integrate publicly available control variables retrospectively such as social media data or economic indicators.	• Conduct statistical testing for differences of subsamples • Conduct wave analysis and test your model at different times • Triangulate your data with publicly available data to gain knowledge based on a larger data resource • Compare your results with previous research • Add economic indicators to control for influence of economic uncertainty. (e.g., unemployment rate)
Pointing out Limitations	**Step 6 – Report contextual change in data collection** Describe your data collection process in detail and point out possible limitations due to external influences based on times of crisis.	• Report the exact period of data collection (DD/MM/YY), striking events and influencing factors that make the results context-dependent.
Interpretation of Results	**Step 7 – Discuss the findings with regards to context and contextual change** Describe the context of your study in detail. Link your results to your unique context and highlight new findings that differ from previous studies. Explain how your results are affected from contextual change and derive conclusions for future research.	• Illustrate how your participants react to uncertainty in times of crisis and how that uncertainty was reflected in your study.
Supplementary Suggestions		
Post-hoc analysis	**Step 8 – Do not be afraid of post-hoc data collection** In the case of surprising results, consider additional data collection as it helps to draw precise conclusions about your findings and how changing context influenced them.	• Collect additional data such as additional survey answers, post-hoc interviews, and social media posts
Discussion	**Step 9 – Consider post-hoc theory development** Consider conducting post-hoc theory development in the discussion that speaks directly to the findings. This will provide a sound foundation for future studies to explore context and contextual change.	• Suggest the extension of established models with new constructs to consider the contextual change

6.2.2. Step 2 – Design your data collection to take the context into account

As you approach data collection, consider whether the context will change the meaning of established constructs or relationships, and if so, what that might mean for the measurement of key constructs.

- *2a – Consider context that might change*. Context is highly dependent on the surroundings and the environment that exits external to the individual (Mowday & Sutton, 1993). Change of context can thus result from different sources, such as social, regulatory, economic, technological, or

environmental changes, which impact expectations and behaviour of individuals. When designing your study, consider how context might have changed in comparison to established theory. Watch out for the many faces of context that touch your study and how your contextual situation might be different from previous research (Johns, 2006). As these disruptions are often wicked problems, also look for incidents related to them that reflect the ball of contextual change or signal contextual change in progress (Rousseau & Fried, 2001). For instance, while the current pandemic is often declared to be the trigger for changes in behaviour and expectations of individuals, in many cases it is not only the pandemic but rather its consequences that trigger these changes. For example, it is most likely the economic uncertainty that leads to insecurity among employees regarding their future job situation, not the pandemic itself. Do not risk missing the contextual change by focusing too much on the initial stimuli.

- *Step 2b – Consider how the data might be context sensitive*. Pay special attention to your constructs and evaluate whether, and the extent to which, their meaning and measurement is context sensitive. As scales are often tailored to a context, it may not be enough to only check the construct definition itself. Rather we recommend examining context sensitivity on the item level. For example, the scale for turnover intention in our study considers two different time frames (Moore, 2000). While three questions ask for turnover intention in the next year, one question asks for turnover intention in the next five years. Naturally, the questions on the turnover intention next year were more affected by the progress of the pandemic than the question about the turnover intention in five years, since presumably the majority of the respondents hoped that the situation would have stabilised within five years. We recommend going through every single item in your study to see if a changing context could influence the answers of the survey participants. While we do not want to recommend unnecessarily adapting established scales, we would like researchers to consider collecting additional items and tweaking construct measures to tailor them to the current context. By adding items, we can have some consistency with the literature, while at the same time taking into account the changes. An example for an additional question to measure turnover intention would be – *"After COVID-19, how likely is it that you will take steps to secure a job at a different company?"* In addition to a traditional question for turnover *"How likely is it that you will take steps during the next year to secure a job at a different company?"*
- *Step 2 c – Collect context-specific control variables*. Include variables which pay attention to the context as a control in your research. Select the control variables that are relevant to your study and research project. These control variables not only help to control for external influences, but also to detect any rapid disruption during the data collection (e.g., by observing shifts in the answers over time). Control variables can capture "noise" attributable to respondents' behaviour, attitude and perception. For instance, when you are interested in studying turnover, we recommend including questions about how respondents perceive the future of their company. For studies that are strongly influenced by emotional states, scales such as negative affectivity (Moore, 2000) help to control for the negative emotional state of respondents. For studies that might be influenced by uncertainty due to crises, scales such as coping with change help to control for the respondents' attitudes towards change (Cunningham, 2006).

6.2.3. Step 3 – Document the data collection process to consider contextual change

During data collection, it is important to document real or potential critical incidents, such as real-world events, government actions, and media reports, to be able to later test their influence in post-hoc analysis. For this purpose, we recommend recording occurrences and your responses to them as closely as possible to data collection, such as press releases concerning the target group, development of economic KPIs, or announcements in the company (see Table 2 as an example). If the study context is dependent on the economic situation, public data such as the unemployment rate or company data such as revenue trends provide reliable information on economic disturbances. Such data could be augmented with scraping social media posts on Twitter or Facebook that capture the sentiment felt by members of your sample frame. Keeping track of such incidents during the data collection facilitates the investigation of their influence in subsequent analysis. Furthermore, doing so in near real-time ensures that you have some understanding of how participants likely felt as they provided data.

6.3. Retrospective steps

For researches working with data that might be subject to contextual change, we recommend to consider six additional steps in their research process:

6.3.1. Step 4 – Check your data for contextual change

After data collection, we recommend investigating whether the data collected is affected by external influences. This is particularly true for data that is

potentially highly dependent on shifts in the economic situation or changes in people's public life, work life, and private life, for example. A first review of the data can be a simple check of the descriptive statistics. Check means, distribution, standard deviation, excess kurtosis, and skewness of your variable and look for unexpected high or low values. Also look for unusual outliers and missing data. A second review of the data should involve testing the initial theoretical model to see how expected results differ from actual results. If the results deviate strongly from established theories, as was the case with our data, this could be attributable to the influence of changing context. Furthermore, it can help in investigating the influence of time on the model by considering different periods of time. To do so, create a progressive, dummy variable and test its impact on the dependent and independent variables of your model (see our approach in Act Two). If an influence can be identified, for example, by regression or correlation, it will become necessary to isolate this influence.

6.3.2. Step 5 – Conduct robustness checks

Consider multiple robustness checks for contextual change. As mentioned before, contextual change can result from different sources of shifts, such as social, regulatory, economic, and technological changes. We encourage researchers to look at relevant literature and theories and decide for themselves which scales and items need special attention. With that said, we recommend these robustness checks.

- *Step 5a – Isolate the influence*. Analyze the influence of the contextual change on the data in detail. This can be done by splitting the data and observing the difference between data samples. First, split your data set into different time periods. This division allows the data to be compared over time, which might reveal the impact of critical incidents in patterns. Pay particular attention to critical incidents that you identified in *Step 3*. Second, split your data sample based on demographic variables, such as place of residence, age, or gender. This division allows the data to be compared for differences in responses or behavior of participants, which are based on the characteristics of the respondents. For example, parents may be more affected by the current regulations on working from home than respondents living alone. After splitting the data set, run the following robustness checks. First, visualize individual constructs and their development over time. By means of visual deviation you can see whether variables have changed during the course of data collection (see Figures 2 and 3 in Act Two). Second, compare the split data samples based on time or demographics and identify significant differences between samples. With normal distribution, these can be verified by means of an independent t-test (2 samples) or an ANOVA test (several samples). For data without normal distribution, use non-parametric tests such as the Wilcoxon-Mann-Whitney test (2 samples) or the Kruskal Wallis test (several samples). Lastly, running the model at different points in time of data collection or for different groups of respondents provides information on how responses have changed due to critical incidents (see Figures 4 and 5 in Act Two). To do this, map your data with events that you identified while collecting the data as well as incidents that assumed greater post-hoc importance (see Table 2). Triangulating your data with publicly available data from remarkable events allows you to gain knowledge based on a larger data resource. These can be major events such as the announcement of the lockdown in our study, or simply an internal company announcement in the firm in which the study is being conducted. When doing so, take care to consider whether there is a lag in the events effects on your data. In the case of COVID-19 in Germany, the consequences of short-time work on the attitude of German employees could only become noticeable with a delay after weeks or months of reduced working hours, and consequently also salaries. By considering remarkable events, you create an opportunity to check whether you can identify the influences of these events. Using multigroup analysis you can then determine whether the samples differ significantly from each other (Ahuja & Thatcher, 2005; Qureshi & Compeau, 2009).

  If your variables are not time-sensitive or you are not able to compare samples based on demographics, it is a good idea to compare the data collected with past studies. When doing so, consider the context (temporal context, cultural context, characteristics of the respondents, etc.) of the current and past studies. You may find instructions for comparing replica studies to be helpful in this regard (Simonsohn, 2015). Check to what extent established relations in theories can be verified in your study or whether they turned out differently than assumed. Compare the quality criteria of your study with comparable, earlier studies. Note if there are differences in the descriptive statistics (e.g., means, distribution). Compare the internal consistency reliability, the convergent validity, and the discriminant validity of your constructs with the same constructs of previous studies (e.g., Cronbach's alpha, AVE, outer, and cross loadings). Deviations in these values provide information

at the item as well as the construct level. Third, compare the relations (e.g., signs and significance), as well as the coefficient of determination (e.g., R^2) to detect deviations of relationships in the models. Finally, likelihood-ratio tests let you assess the goodness of fit of your model compared to the models of previous research (Glover & Dixon, 2004). Investigate what circumstances and context caused the results of your study to differ from the results of previous studies. At the end of this step, you should have an understanding of which variables have been influenced by the changing context and how this influence has affected them (increasing, decreasing, inverted directions, no change).

- *Step 5b – Control for the influence*. If you decide that your data remains useful, despite the influence of the contextual change, we recommend to include control variables in your analysis. These may be control variables which you specifically considered for the control of contextual change in the data collection process (see *Step 2 c*). However, also consider data that are publicly available and can be integrated in the analysis retrospectively. Examples for retrospective control variables are social media data, stock prices, or regular business reports of firms. Depending on the type of influence, you should consider different types of control variables. Control time-sensitive data by using a dummy, progressive control variable, which reflects the chronological course of the data collection (see Act Three). Alternatively, a simple, binary variable (0|1) can be introduced to control the influence of a specific event. Furthermore, control data that correlates with the economic situation with the aid of economic indicators. For example, data that depends on the job market can be controlled by the unemployment rate or the number of job offers (see for example, Joseph et al. (2015)). Lastly, control data that is impacted by the perception and attitude of individuals with sentiment data scraped from social media posts or psychological scales such as negative affectivity (Moore, 2000).

6.3.3. Step 6 – Report contextual change in the data collection

Our experience illustrates how data collection can be time sensitive. Even if timing has been treated as an essential contextual factor in management research (Mitchell & James, 2001) we rarely see the timing of data collection reported in papers. We completed a closet analysis of the papers published in EJIS since 2015, which included data collection (quantitative + qualitative; n = 103) and found that only 32% (33 articles in total) reported specifications of the time of the data collection. Of those papers, 20 reported the year of the data collection. Eight articles reported the month, and only five articles reported the specific dates. If data were collected during a time of contextual change, this must be made transparent in the reporting of the study. Our experience suggests a need for providing greater detail (than typically found in IS journal papers), of data's provenance, particularly for data collection disrupted by external factors. It is important to clearly explain how the research design was originally planned, what data was collected, when data was collected, and how the data compares to existing studies. This will make it easier for the reader to assess the impact of contextual change – such as what is happening through COVID-19 – on the study's findings.

6.3.4. Step 7 – Discuss the findings with regard to context and contextual change

Finally, it is equally important to relate the results found to the current situation of the pandemic, and accordingly, to explain how the global crisis might have affected the results in concrete terms. In the case of our study, the decrease in turnover intention illustrates the uncertainty that IT professionals are currently facing. In uncertain times, risk affinity decreases and at the same time the willingness to change the current job (Callanan et al., 2017). An increase in affective commitment and person-organisation fit is most likely due to the positive responses of companies to the COVID-19 crisis. The increase in professional commitment could be explained by many IT professionals now realising that the IT profession is a robust profession with good future prospects, which can be practiced independent of the workplace. By discussing the effects found in the data, we can gain a better understanding of the events of the current crisis and their impact on social and behavioural IS research.

6.4. Supplementary suggestions

6.4.1. Step 8 – Do not be afraid of post-hoc data collection

One implication of your study could be that theories cannot be applied as expected. As in our case, established models could not be confirmed, which led us to investigate how the changing context impacted our study. In order to glean further insight into these phenomena, we conducted post-hoc interviews. Do not hesitate to collect additional data, it could be extra, time-delayed answers of the same survey, or other forms of data, such as post-hoc interviews or social media posts. This additional data collection allows you to draw more precise conclusions about the context change and its implications on the findings of your study. Repeated collection of the data with the

same sampling also opens up the possibility of longitudinal research and thus provides insights into changes over time.

6.4.2. Step 9 – Consider post-hoc theory development

Detecting different results than expected due to context change raises the question of how to deal with resulting new findings. We argue that it suggests a need for post-hoc theory development in the discussion that speaks directly to the findings (Durcikova et al., 2018), especially if the contextual change is so radical that theories can no longer be applied and therefore have to be developed anew. The bar for such post-hoc theory development should not be primarily whether it is completely generalisable, but rather whether it is accurate and faithful to the data which was collected and whether it is parsimonious vis-a-vis to the phenomena of interest. By doing so, researchers create opportunities for enriched understanding of how the sociotechnical context is shaped by broader health, social, or economic conditions.

6.5. Radical contextual change and theory change

We recognise that our guidelines are primarily motivated by the assumption that contextual change during the data collection needs to be sought and detected. We also acknowledge that there are contextual changes and circumstances that might lead to such radical shifts that they are hard to overlook. However, these radical changes shift the theoretical lens in such a way that theory is not applicable anymore, leading to a Promethean leap (Conboy, 2019), meaning that it represents something unprecedented.[2] One example is the introduction of the General Data Protection Regulation. Its introduction in 2018 caused a major shift of context, entailing the development of new theories on data protection and related behaviour since then. This type of radical contextual change is well illustrated by the results of a recently published replication study examining privacy behaviour (Hermes et al., 2020). In their replication study, the authors find significant differences in the disclosure behaviour of their participants compared to the original study, which they attribute in part to the introduction of the GDPR that took place between the two studies. The authors argue that due to the recent discussions on GDPR, the participants in their study may have developed such a strong affinity for privacy that they were no longer willing to reveal their actual disclosure behaviour.

In the case of radical contextual change, we recognise that the guidelines as we describe them are only applicable to a limited extent. We also point out that contextual change may be too radical to be captured by measures in data collection or analysis. As mentioned in Step 1 of our guidelines, researchers experiencing radical contextual changes may opt to consider a shift of the theoretical lens and acknowledge this shift in the limitations and the discussion of the findings. This allows radical contextual change to be used as an opportunity to redefine IS problems and develop new IS theories rather than only seeing it as a threat to generalisability. A world full of rapid and radical change may seem daunting at first glance, but is also a valuable opportunity for IS researchers to invigorate the understanding of how the environment affects research.

7. Conclusion

Global crises, such as the COVID-19 pandemic, present many researchers with professional challenges. While the world society is currently disrupted, the contextual change resulting from the shifts in global economy brings with it implications for IS researchers to think about the interplay between context, research design, and data quality. On the one hand, this change poses significant threats to generalisability, but it also opens up numerous opportunities to study boundary conditions on IS research that are difficult to study under "normal" circumstances. Based on lessons drawn from our confessional tale, we draw researchers' attention to the perils of conducting research in an environment of changing context as well as offer recommendations on how to address disruptions in data collection rooted in the context. We hope that our experiences will help future researchers navigate the unexpected in what appears to be an interesting juncture in our shared global experience.

Note

1. To prevent layoffs, companies in Germany are allowed to announce short-time work if the regular working hours have to be reduced temporarily for economic reasons or due to unavoidable events. Employees are guaranteed at least 60% of their net salary, regardless of the actual hours worked. Gaps between the reduced salary and the guaranteed short-time working payment are compensated by the Federal Employment Agency.
2. We thank the senior editor for bringing these radical contextual changes to our attention.

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Appendix A Data analysis

Preliminary analysis of our data indicated non-normal distributions in the data, which is why we decided to use techniques robust to non-normal distributions to test the differences between the waves as well as to test the whole model. As PLS-SEM is known to be able to handle data with non-normal distribution as well as formative constructs, we decided to analyse our model with PLS-SEM, and selected SmartPLS as the appropriate software tool (Ringle et al., 2015). In the following, we provide details about the analysis process. Table 6 provides information on the descriptive statistics of the data. Tables 7 and 8 provide information on the evaluation of the measurement model, as well as of the structural model.

To check the reliability and validity of the constructs, we used Cronbach's alpha and average variance extracted (AVE) (Hair et al., 2016). Our data indicated both reliability (Cronbach's Alpha > 0.8) and validity (AVE > 0.6). To assess discriminant validity, we calculated the square root of the AVE of each construct and compared it with correlations among the latent variables. Furthermore, we checked the items' loadings as well as cross loadings of the constructs. All items loaded higher on the intended construct than on all other constructs (Hair et al., 2016) . Both checks prove the constructs' discriminant validity. Please note that we have decided to reduce the items of the construct "professional ambition" because of low factor loadings. Although this meant that we had to measure professional ambition based on a formative two-item construct, we decided to keep the construct in the model, because we believe it helps to make the influence of contextual change in our data collection process transparent. Lastly, as the correlation matrix indicates high correlation between affective commitment and person-organisation fit, we examined VIF to detect issues with collinearity. However, all inner VIF values were clearly beneath the critical value of 5, which proves the correctness of the model.

Table 6. Descriptive statistics.

Item	Mean	Median	Standard Deviation	Excess Kurtosis	Skewness
Training (6 months)	0.737	1.000	0.440	−0.825	−1.088
AC1	5.034	5.000	1.808	−0.497	−0.701
AC2	5.597	6.000	1.435	1.517	−1.336
AC3	5.520	6.000	1.563	0.559	−1.130
AC4	5.376	6.000	1.652	0.346	−1.062
JS1	5.497	6.000	1.355	1.559	−1.420
JS2	5.164	5.000	1.382	0.919	−1.100
JS3	5.531	6.000	1.338	2.255	−1.505
PJ1	5.418	6.000	1.416	0.501	−1.011
PJ2	5.436	6.000	1.286	0.142	−0.762
PJ3	5.367	6.000	1.436	0.081	−0.873
PC1	5.039	5.000	1.548	−0.220	−0.634
PC2	5.458	6.000	1.411	1.412	−1.285
PC3	5.230	6.000	1.539	0.148	−0.933
PC4	5.475	6.000	1.366	0.726	−1.053
PO1	5.101	5.000	1.536	−0.164	−0.777
PO2	5.153	6.000	1.549	0.048	−0.883
PO3	5.258	6.000	1.522	0.239	−1.024
PA1	6.260	6.000	0.877	3.685	−1.600
PA2	5.337	6.000	1.245	1.245	−1.174
TI1	2.212	1.000	1.658	1.349	1.460
TI2	3.243	3.000	1.946	−1.020	0.419
TI3	3.297	3.000	1.837	−0.718	0.531
TI4	3.235	3.000	2.000	−0.989	0.514

Table 7. Correlations, AVE, and Cronbach's Alpha*.

	Affective Commitment	Job Satisfaction	Prof. Ambition	Perc. Job Alternatives	Person Organisation Fit	Prof. Commitment	Training 6 Months	Turnover Intention
Affective Commitment	**0.727**							
Job Satisfaction	0.603	**0.826**						
Prof. Ambition	0.325	0.254	-					
Perc. Job Alternatives	0.239	0.163	0.289	**0.846**				
Person Organisation Fit	0.804	0.723	0.276	0.165	**0.855**			
Professional Commitment	0.439	0.408	0.315	0.104	0.389	**0.697**		
Training 6 Months	0.208	0.145	0.185	0.046	0.193	0.065	-	
Turnover Intention	−0.607	−0.512	−0.083	−0.021	−0.581	−0.310	−0.176	**0.770**
Cronbach's Alpha	0.874	0.895	-	0.909	0.915	0.851	-	0.900

*As professional ambition was measured as a formative construct, it is not appropriate to report or interpret AVE or reliability.

Table 8. Loadings and cross loadings.

	Affective Commitment	Job Satisfaction	Prof. Commitment	Perc. Job Alternatives	Person Org. Fit	Prof. Ambition	Turnover Intention	Training 6 Months
AC1	**0.850**	0.497	0.459	0.106	0.682	0.216	−0.636	0.118
AC2	**0.768**	0.517	0.271	0.267	0.585	0.341	−0.424	0.281
AC3	**0.894**	0.473	0.383	0.273	0.683	0.296	−0.480	0.163
AC4	**0.891**	0.569	0.359	0.196	0.782	0.273	−0.497	0.167
JS1	0.579	**0.919**	0.338	0.184	0.687	0.194	−0.464	0.116
JS2	0.581	**0.921**	0.404	0.115	0.716	0.280	−0.489	0.163
JS3	0.479	**0.887**	0.369	0.149	0.562	0.213	−0.440	0.113
PC1	0.324	0.328	**0.808**	−0.018	0.260	0.211	−0.294	−0.034
PC2	0.417	0.318	**0.704**	0.215	0.351	0.306	−0.219	0.122
PC3	0.370	0.348	**0.906**	0.117	0.325	0.298	−0.232	0.106
PC4	0.363	0.365	**0.905**	0.056	0.366	0.246	−0.280	0.040
PJ1	0.198	0.114	0.045	**0.934**	0.132	0.209	−0.022	0.047
PJ2	0.245	0.160	0.157	**0.898**	0.173	0.387	−0.029	0.034
PJ3	0.221	0.185	0.096	**0.926**	0.157	0.213	−0.004	0.043
PO1	0.700	0.651	0.354	0.200	**0.905**	0.285	−0.505	0.213
PO2	0.807	0.689	0.362	0.115	**0.949**	0.251	−0.589	0.148
PO3	0.717	0.666	0.364	0.148	**0.918**	0.231	−0.513	0.177
PA1	0.224	0.112	0.199	0.211	0.145	**0.898**	−0.047	0.178
PA2	0.299	0.355	0.323	0.243	0.342	**0.506**	−0.094	0.070
TI1	−0.518	−0.445	−0.312	−0.016	−0.491	−0.009	**0.873**	−0.115
TI2	−0.545	−0.473	−0.285	−0.032	−0.526	−0.124	**0.917**	−0.197
TI3	−0.557	−0.433	−0.296	−0.024	−0.529	−0.077	**0.823**	−0.123
TI4	−0.508	−0.443	−0.190	0.000	−0.489	−0.079	**0.895**	−0.184
Training	0.208	0.145	0.065	0.046	0.193	0.185	−0.176	**1.000**

Short-term Affair or Long-term Commitment?

An Investigation of Employees without IT Background in IT Jobs

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ABSTRACT

The IT profession is constantly changing. The rapid development of technology and the high demand for IT specialists has led to a broader and more diverse profile of IT professionals with fewer boundaries regarding organizations and occupations. As a result, companies have encouraged the migration of employees with different backgrounds into the IT sector. Drawing on the theory of the boundaryless profession, we explore this transformation in IT careers. By studying 355 career sequences of IT professionals in Germany, we investigate the career mobility of employees without an IT background working in IT jobs. Our results show that only around one-third of employees without an IT background remained in IT for the long-term. The majority of the sample, however, either returned to their original sector or moved to another after a few years in IT. Our study contributes to a better understanding of the boundaryless IT profession and sheds light on the role of employees without an IT background in IT jobs.

CCS CONCEPTS

• Social and professional topics ~ Project staffing • Social and professional topics ~ Computing occupations

KEYWORDS

IT workforce; IT professionals; boundaryless career; career transition; IT experience

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1 Introduction

The IT profession is subject to constant development. In order to keep up with the rapid change of technology, the skill requirements for IT professionals are constantly evolving [17]. While in the past it was primarily the technological skills that IT professionals had to bring along to be successful, today it is more than ever also non-technical skills that are in high demand [17, 22]. With the increasing importance of business domain, project management and social skills, the profile of the IT workforce is changing. As a consequence, a new generation of IT professionals is entering the IT job market and the IT workforce is becoming broader and more diverse [4, 5].

As a result of this development, the concept of the boundaryless IT profession has generated increasing awareness [30, 48]. Boundaryless professions describe careers in a professional market in which individuals choose to switch between companies, as well as between occupations [6, 45]. Being characterized by high turnover, as well as turnaway rates, the description of the boundaryless profession matches characteristics of the IT profession [29, 48]. Whereas the transition from IT professionals to other occupations as one specification of the boundaryless profession has already been studied extensively [see for example: 12, 29, 43], another variation often remains unobserved in IS workforce research: The transition of employees without an IT background into the IT sector.

Due to the increasing attention to technology and the high salaries for IT professionals [19, 50], the IT sector has become a highly appealing job market for employees with various backgrounds. Because of the rapid development of technology and the high investments in the technology industry worldwide [18], IT professionals are in great demand. The current predicted growth

rate for IT jobs in the US within the next ten years is 11 %, representing a much faster growth rate compared to all other occupations [13].

In Germany, too, the demand for skilled IT personnel is increasing. An annual study conducted by Bitkom Research has recorded a high increase in open IT positions in Germany for years. For 2020 Bitkom Research has announced a 51% increase in unfilled IT positions. This corresponds to 124,000 vacant IT positions in Germany in 2020 [9]. Consequently, technology companies are looking for alternative ways to fill open IT positions.

A career in IT no longer only requires a typical technological career path based on a strong technological background. Rather, companies such as IBM or Microsoft are demanding alternative ways to open up the IT sector [34]. The shortage of skilled workers, but also the possibility to integrate various knowledge from different areas, let companies hire also job candidates with non-IT specific background. Since this change on the IT market could finally counteract the high shortage of IT specialists, it is advantageous to gain an improved understanding of employees without an IT background in IT jobs. We therefore intend to investigate the following research question:

RQ: What are different career paths of employees without an IT background working in IT Jobs?

To answer this question, we examine career paths of IT professionals without an IT background based on a sample of 355 German IT workers. By replicating the approach of Joseph, et al. [30], we aim to derive different patterns of job mobility of career changers who switch to IT after having gained work experience in another sector. Our paper is structured as follows: First, we provide an overview of traditional and modern career path patterns in the IT sector. We then describe the research method and give information about the data collection process. After presenting the results of the study, we discuss theoretical contributions and future research.

2 Theoretical Background

2.1 Traditional careers in IT

Careers are defined as "a sequence or combination of occupational positions held during the course of a lifetime" [51, p.286]. Even if this form of professional movement covers switches between both occupations and organizations, traditional career definitions and mobility models are based on the understanding of a career as a linear progression of job responsibilities [33]. Thus, traditional career paths in IT assume a sequential flow indicating that previous job stages provide all the necessary training to be successful in the next one [20, 26].

In early IT career research, traditional career paths in IT followed the concept of dual career paths [15, 37]. This career model describes two distinct career paths in IT: technical and managerial. These two career paths differ not only in the characteristics of the professionals who follow them, but also in the level of commitment to the profession and organization. Individuals following a technical career have a strong commitment to technical competence. They usually remain in a technical job during their whole career, as that they are more bound to the IT occupation, than to their organization [30, 32]. In contrary, IT professionals with managerial career paths feel more committed to their organization than to their occupation [44].

With the current changes in the IT workforce and a new generation of IT professionals entering the IT sector [4, 5], the job mobility of IT professionals is evolving. It is therefore important to examine modern careers in IT.

2.2 Modern careers in IT

Deviating from the traditional career model, the more recent IT workforce research has shown that IT careers now unfold in a variety of directions [26, 30, 48]. High turnover as well as turnaway rates in the IT sector [29] indicate the boundaryless character of the IT profession [27, 48]. The boundaryless career model has been described "as being the opposite of organizational careers" [7]. It separates the individual's career from organizational and professional boundaries, resulting in professionals frequently leaving and entering the IT sector.

Employees following boundaryless careers are detached from hierarchical structures and advancement structures within organizations. Consequently, individuals become self-determined actors in their own careers [6]. Rather, they draw validation from outside their employer, often following careers that are sustained by external networks. Instead of making use of career opportunities within one organization, those individuals make career decisions based on personal or family reasons [7, 11].

In IT different forms of boundaryless careers were identified. Joseph, et al. [30] characterized three distinct career paths of IT professionals that are all boundaryless in different forms: (1) IT career path, (2) the secondary labor market career and (3) the professional labor market career. Persons pursuing IT career paths showed job mobility that was boundless across companies. However, people pursuing secondary and professional labor market careers tended to be more inclined to cross occupational boundaries. Slaughter et al. [49] discussed this observation in detail. While IT professionals who start their career with an IT job, were found to be bound within their profession but not within their organization, individuals who started their career in a non IT job and moved in and out of the IT career at later stages were neither bound to profession nor organization [48]. This finding indicates a higher degree of boundlessness of IT professionals entering the IT sector after having gained work experience in other sectors.

In our study we therefore concentrate on the second form of boundaryless careers in IT and investigate IT professionals without an IT background switching to the IT profession at some point in their careers. Through this focus, we hope to create a better understanding of how career change is handled in IT professions and whether increased hiring of career changers can help companies fight future shortages of IT professionals.

3 Research Method

For investigating career paths of IT professionals without an IT background, we followed the approach of Joseph, et al. [30]. We analyzed career patterns in the German IT sector by generating career sequences out of a German longitudinal data set and clustering them based on their characteristics

3.1 Data collection

To analyze career patterns in the German IT sector we used the microdata provided by the German Socio-Economic Panel (SOEP) study [21]. The SOEP is a longitudinal and representative national survey, which gets conducted in Germany annually since 1984. In total the study gathers answers from roughly 30.000 individuals living in ca. 15.000 households. The collected data covers topics like household demographics, education, employment, earnings as well as subjective indicators of well-being such as attitudes, values and personality. Since the SOEP contains information on the development of careers over the last 30 years and has already been successfully used to study boundaryless careers in Germany [8], we conclude that the dataset is a suitable data source to study boundaryless characteristics of IT careers in Germany.

Following the approach of Joseph, et al. [30], we first built career sequences by coding the information of the employment per respondent per year according to the International Standard Classification of Occupations (ISCO).

Table 1: Job codes and definitions (based on Joseph et al. (2012))

Job Type	Class Code	Description
IT	**I**	Technical IT job (e.g., systems analyst, programmer; software and hardware engineer; IT support specialist)
IT	**M**	Managerial IT job (e.g., computer and information systems manager)
Non-IT	C	Clerical job (e.g., clerk, secretary, administrative support worker)
Non-IT	G	Non-IT managerial job (e.g., manager)
Non-IT	J	Technical administration job (e.g., computer equipment operator)
Non-IT	O	Craft, production and service job (e.g., protective service, food/beverage worker, service worker)
Non-IT	P	Non-IT professional job (e.g., accountant, legal professional, psychologist, scientist)
Non-IT	S	Sales job (e.g., retail salesperson, insurance sales agent,)
Non-IT	T	Technician (e.g., engineering / healthcare / chemical technician)
Non-IT	Y	Military service
Non-IT	U	Enrolled in school or unemployed

For the classification of the employment, we coded the respondents' jobs for each year, starting with the year 1984. By aligning the occupation codes per year per respondent, we built career sequences, which illustrate the development of a career of the years. Table 1 provides an overview of the classification.

An example of a career sequence is the following: (seq_{321}= S,S,S,O,O,T,T,T,I,I,I,I,I,I,I). The respondent started his/her career with a sales job and changed into a craft, production and service job after three years. After another two years of work experience he/she changed into a more technical direction by working as a technician. Finally, after eight years, the respondent started a technical IT job, in which he/she stayed till the end of his/her career. Since the goal of our study is to understand individuals changing job types, we did not consider changes of employers.

A disadvantage of national surveys is that the career sequences of the participants are usually from different length, which makes careers difficult to compare. To reduce this noise in the data, we decided to cut the career sequences after 15 years.

As a second step, again following the example of Joseph, et al. [30], we restricted the sample based on the following requirements: (1) respondents must be at least 18 years old, (2) respondents have worked in a full-time IT job for at least one year, (3) respondents must have work experience of at least five years. In order to filter professionals who have worked in IT for at least one year, we classified I Technical IT job and M Managerial IT job as IT jobs. All other job types were classified as non-IT jobs. Limiting the sample to people who are at least 18 years old and have worked in IT for at least one year (code I or M) reduced the sample to 1595 individuals. By restricting the sample to at least five years of work experience we limited the data set to n = 1110. Since our focus was on researching employees without an IT background, we then only considered individuals who had worked in another sector for at least 3 years before entering an IT job. This resulted in a final dataset of n = 355.

3.2 Data analysis

For the analysis of the career paths of employees without an IT background, we followed the approach of Abbott and Hrycak [2], which was also used by Joseph et al. [30]. The analysis consists of two types of analysis: optimal matching analysis and clustering analysis. For the calculation of the analyses we used the program R. The used packages were Trajectory Miner (TraMineR) for the optimal matching distance and stats (hclust function) for agglomerative clustering of dissimilarity.

Optimal matching analysis

After building the career sequences for all 355 individuals, we proceeded with the optimal matching analysis by calculating the similarity of the sequences [14]. This is done by a pair-wise computation of operations needed to transform one sequence into another. The most similar pairs of sequences are defined as the ones with the least transformation "cost" of a career sequence to another [1]. The result of the optimal matching is a distance matrix representing the pair-wise similarities of the distinct sequences.

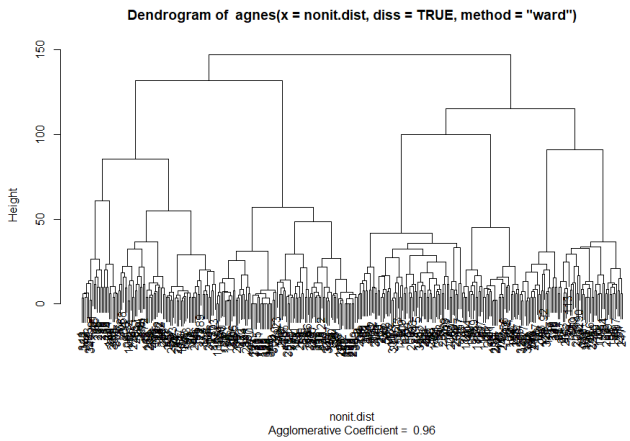

Figure 1: Dendrogram for career path clusters

Cluster analysis

Finally we grouped the career sequences into clusters depending on their similarity scores. For the clustering of the data set we used the hierarchical agglomerative clustering technique by Ward [39]. The clustering algorithm compares the similarity scores of the sequences on how similar they are in comparison to all other similarities of the data set. The result is a dendrogram, which can be seen in Figure 1. The dendrogram suggests a cut at height 80 indicating a seven-cluster solution [2, 30].

4 Results

The cluster analysis resulted in an optimized division of the career sequences into seven clusters. After investigating the clusters, we assigned them to three categories: 1) Long-term stayers, 2) Short-term visitors, and 3) Others. 117 career sequences belonged to category 1 Long-term stayers (= 33%), 117 career sequences belonged to category 2 Short-term visitors (= 47.8%) and 68 career sequences belonged to category 3 Others (= 19.2%). Figure 2 visualizes the three categories and their assigned clusters. In the following we explain the categories as well as the clusters in detail.

4.1 Long-term stayers

The category "Long-term stayers" consists of two clusters: C1: IT career and C2: IT management career. 117 careers (33%) are allocated to this category. Long-term stayers are characterized by starting their careers in non-IT jobs, move to IT jobs after a few years of work experience and finally gain a long-term foothold there. Thus, careers in this category could be regarded as the successful career changers to the IT industry. In the following, we explain the two assigned clusters in detail.

We label cluster 1 as C1: IT career. With 93 career sequences (= 26.2% of the whole sample), this career type represents the largest of all identified clusters. Employees who choose this career path predominantly have a background in technical labor (n=46). After five to seven years, they usually change to the IT sector. Once in IT they stay there till the end of their careers. 20% of the employees in C1 begin their careers with non-IT professional jobs and change to the IT in years five or six. The third most strongly represented group is that of craft and clerical workers. Around 10% of the employees who make a successful switch to an IT career come from this sector. Bevor switching to IT, they typically work in technical or sales jobs, till after five to seven years of work experience they switch to IT job positions. The remaining 20% of the employees assigned to C1 start with unemployment or education for one to five years, change to non-IT professional jobs, clerical work or technical jobs for a few year, followed by IT employment in years eight to ten.

We label cluster 2 as C2: IT management career. Consisting of only 6.7% of the dataset (n=24), this allocation represents a rather small cluster. Representatives of this group have a background in non-IT professional jobs or management jobs (n=16, 66.6%). Individuals in this cluster typically spend the first half of their career in general management or non-IT professional positions to switch to IT management employment afterwards. Compared to the IT career, in which the respondents remain sustainably attached to the IT jobs, this cluster is characterized by a greater willingness for job mobility, also in later years. 37.5 % of the individuals changed to IT jobs or management jobs in the last three years of the observed career sequences after they had already held IT management positions.

4.2 Short-term visitors

The category "Short-term visitors" consists of four cluster types: C3: Technical career, C4: Non-IT Professional career, C5: Craft career and C6: Clerical career. 170 careers (47.9%) are allocated to this category. This category is characterized by employees who start their career outside IT, then work in IT for a few years, to either return to the old sector or move to another sector afterwards. Thus, careers in this category can be considered short-term visitors to the IT sector. Due to their willingness to change sectors, these employees show a high degree of boundlessness. In the following, we explain the four assigned clusters in detail.

We label cluster 3 as C3: Technical career. 25 careers (7%) belong to this cluster. Representatives of this group have a strong focus on technical jobs and either start or end their career as technicians. In between representatives of this cluster usually spend between 3 to 5 years in IT jobs. 16.7% in this cluster have started their careers in clerical jobs, switched to IT in their fourth or fifth year to later switch to technical jobs. The remaining sequences start in varying industries, have IT jobs between the years five and ten and continue their careers with technical jobs.

We label cluster 4 as C4: Non-IT Professional career. 64 careers (18%) belong to this cluster. It is characterized by individuals spending most of their time in non-IT professional jobs and visit IT jobs during their career or late towards the end. 40 sequences (62.5%) start in non-IT professional jobs and change into the IT sector between years six and twelve. The remaining sequences start with one to two years of unemployment/education, continue with non-IT professional jobs and have longer periods of IT employment in the second half of their career.

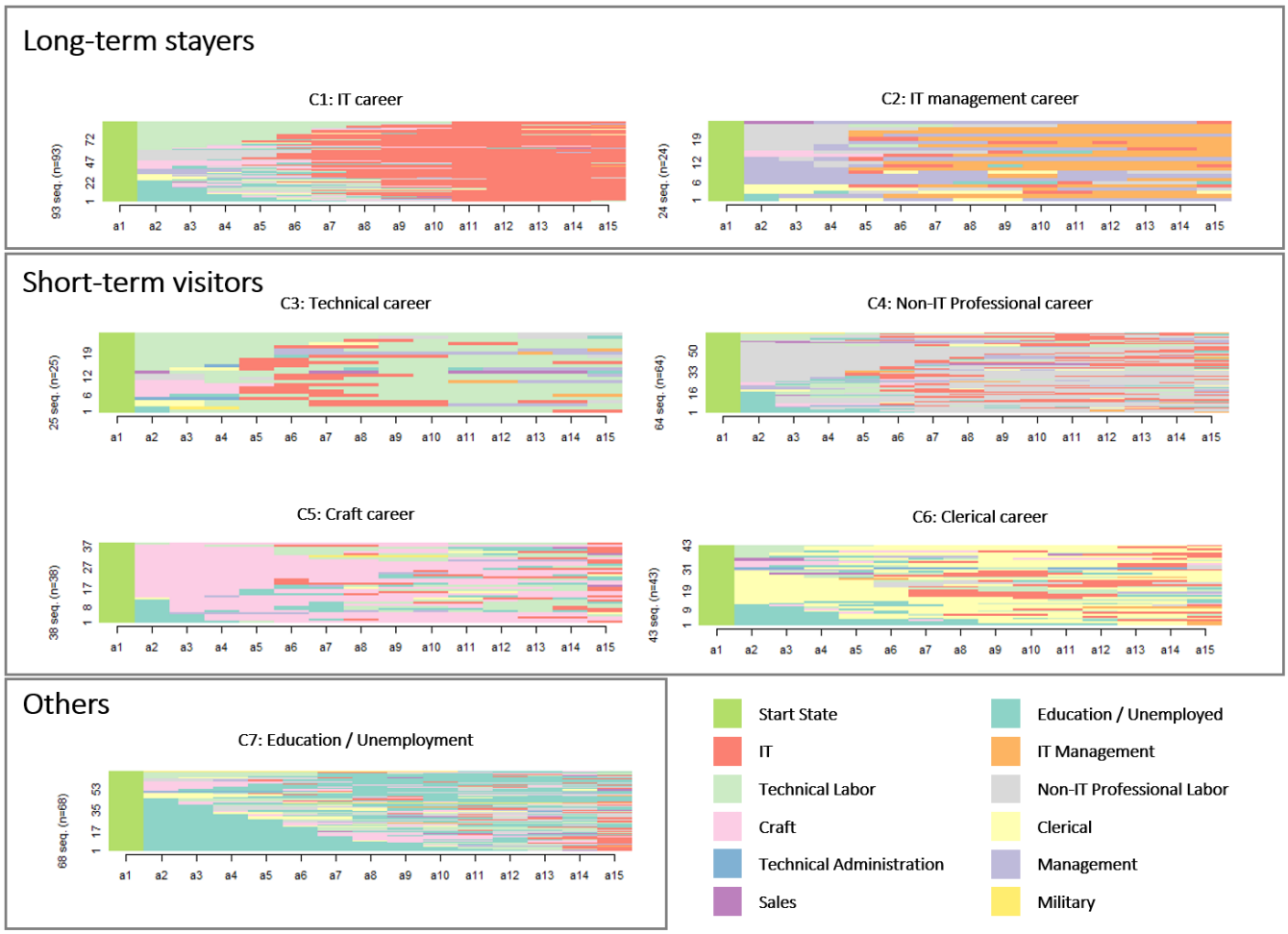

Figure 2: Career sequences of employees without an IT background in IT jobs

We label cluster 5 as C5: Craft career. Individuals allocated to C5 (n=38; 11% of the sample) spend most of their worktime in craft jobs. 65.8% of this population start with craft jobs and are homogenously staying in this sector until year six. After that the sequences illustrate a varying set of different fields from technical jobs to IT employment or clerical work. The switches into IT are rather short and often last only one year.

We label cluster 6 as C6: Clerical career. Similar to the Non-IT Professional career cluster, people assigned to this cluster tend to visit IT jobs in the middle of their career or late towards the end. However, their focus stays on clerical jobs. This cluster is characterized by a late entry into the IT sector. In average individuals in this sector switch to the IT sector after nine years of job experience. However, this late entry does not contribute to a longer stay in IT. After an average of three years in IT jobs, these individuals move back to the clerical sector or other sectors such as technical work or IT management.

4.3 Others

The category "Others" consists of one cluster only: C7: Education / Unemployment cluster. Making up 19% of the non-IT sample, those individuals spend more than half of the surveyed timespan unemployed or in education. 70% of this population begin in unemployment or education for two to thirteen years, change into a wide set of sectors (e.g. clerical work, craft, or sales) and move sectors frequently with only small amounts of time spent in IT jobs. The remaining 30% start in either technical, craft, or clerical work and change to unemployment or education after three to six years with only small episodes of employment in later years.

5 Discussion

This paper was motivated by the changing nature of the IT profession. To fight the high shortage of IT professionals, companies are encouraging the migration of employees without an IT background to the IT sector. In our study we have examined career patterns of employees without an IT background working in IT jobs. The results show two main categories of career patterns: Long-term stayers and short-term visitors. Individuals belonging to the first category gain a long-term foothold in the IT industry and can thus be described as successful career changers to IT. The second category corresponds to short-term visitors to the IT

industry. They usually return to their original sector or move to another sector after a few years in IT jobs. Comparing long-term stayers (n=117) with short-term visitors (n=170), the results indicate that the majority of employees without an IT background do not stay in the IT sector for the long-term.

5.1 Theoretical contribution

We identify several theoretical contributions associated with this study. First, our study contributes to an improved understanding of the boundaryless IT profession [27, 29, 48]. The analysis of the publicly available career data showed that out of 1100 individuals who had worked in IT for at least one year, 355 individuals had worked in a non-IT job for at least three years before switching to IT. Representing almost one third of the IT workforce, employees without an IT background therefore make up a substantial proportion of IT professionals. We thus shed light on a form of boundlessness that has already been pointed out in earlier studies [48], but to our knowledge has never been investigated in depth. Due to the high demand for IT professionals [29, 31] and the increasing interdisciplinary of the profession through modern methods such as agility [25, 41], we expect a further increase of boundlessness in IT profession.

Furthermore, our study contributes to literature on IT careers, as well as on transitions in IT careers. While numerous studies deal with IT professionals who turn away from IT [see for example: 28, 38, 43], our study examines employees who decide to move to IT. Thus, through our study, we are expanding research on a new facet of career transitions in IT. By analyzing career sequences of employees without an IT background we focused on presenting career transitions of IT professionals without an IT background and grouping them by means of clusters. This allows us to see two different career patterns when it comes to moving to the IT: long-term stayers and short-term visitors.

As the results show, it is certain professional groups that manage a successful, long-term switch to IT. Successful transitions into the IT careers are observed for technical workers as well as for non-IT professional jobs. We assume that the successful transformation is due to the similarity of the occupational groups. Employees working in technical jobs, as well as in non-IT professional jobs have similar educational backgrounds to those of employees in IT and IT management careers, making it easier for them to switch between professions. We therefore suggest that it is worthwhile for companies not only to get in contact with IT professionals with IT-specific background, but also to use career interventions with employees and students of other but similar disciplines in order to attract them to IT for the long- term [47].

A key finding of the results is that only 117 career changers (33% of the observed data sample) managed a successful and long-term transition to IT. The remaining respondents changed back to their original or other sectors after few years in IT jobs. We explain this low transition rate based on the following theories: (1) Lack of onboarding - Onboarding is a crucial issue in IT, especially when it comes to the integration of career changers. Skill gaps in IT are a major problem [36], as they either lead to long unproductive phases of new employees or to dismissal of employees. A lack of onboarding therefore increasingly means that newcomers to IT cannot be kept for the long-term. Since retaining IT specialists is an important task of tech companies [40], companies should in future pay increasing attention to appropriate onboarding measures especially for career changers, e.g. through special training or employee events [35]. (2) Low professional commitment - Employees who pursue boundaryless careers have a low commitment to their profession [6]. The high identification with the IT profession, which IT professionals normally experience [16, 23], might not be as strong for career changers as it is for IT professionals having worked in IT for several years. This could lead to a lower hurdle for lateral entrants to change professions. (3) Exclusion - IT professionals show a high level of ethnocentrism by believing in the inherent superiority of their own occupational group [23]. It might be that employees in IT who do not have the necessary IT knowledge and background are not regarded as fully-fledged members of the IT profession. This is where potential conflicts arise, such as the lack of necessary skills or the use of technical jargon [42]. It is therefore particularly important for tech companies to integrate employees without an IT background accordingly within their organization in order to build IT knowledge as well as professional commitment in the early years of IT employment.

In future, IT workforce researchers should investigate the reasons for lateral entrants to leave the IT sector after just a short period of time. In addition, research is needed that provides insights into the successful hiring of career changers in IT, and that gives suggestions on how to keep career changers in the IT sector for the long-term.

5.2 Practical contribution

Next to the theoretical contribution, our study also provides practical implications. Tech companies are currently faced with the question of how to fill the high demand for IT professionals. A potential way to do this is to hire employees without an IT background and then train them accordingly. However, this step needs to be well planned. As our study shows, only 33% percent of employees without an IT background stay in the IT sector for the long-term. Companies must therefore offset the resulting onboarding costs, such as special training for career changers as well as longer training time against the costs incurred by not filling open IT positions [10]. Furthermore, tech companies should offer an appropriate onboarding program for career changers so that skill gaps are closed as quickly and thoroughly as possible. Finally, companies should promote activities that embed their employees within their organization sustainably [see for example 46].

5.3 Limitations

We would like to acknowledge that this study, as every other study, has limitations. First, our study is based on the analysis of a German publicly available data set. We understand that this specific cultural index as well as the job market situation in Germany might have influenced the career mobility of German IT professionals. However, using SOEP allowed us to conduct a longitudinal study of IT professionals without an IT background that would not have been possible otherwise. We thus follow the example of other career analyses in IS research, which were also limited to country-specific

data sets [29, 30]. Second, to make the career sequences comparable, we have opted for a uniform length of 15 years. This shortening of sequences can mean that we do not record very late lateral entrants who only switch to IT after 15 years. We would therefore like to see this particular group of lateral entrants become the subject of future research. Third, we define IT professionals without an IT background as employees who work in non-IT jobs for at least three years until they switch to IT. While focusing on career changers with work experience outside of IT, we do not consider the educational background of the individuals. We acknowledge that educational background could be a predictor for a change to IT, especially for individuals having received technical education. We will examine the difference between career changers with and without technical education in our next study.

5.4 Future research

The high demand for IT professionals makes the IT sector interesting for other professions, as the sector offers many secure job opportunities. Our study is a first step to explore the career paths of career changers, who enter IT after having gained work experience in other sectors. For future research we would like to know why individuals choose this challenging profession, what motivates them to stay in it or also to leave it after a short time. We therefore call for further research into the reasons for choosing an IT profession (similar to [24]) after having gained work experience in other sectors.

For some years now the IT profession has been referred to as boundaryless. With the speed of the IT profession and the rapid technological change, further development of the IT profession can be expected. We are especially interested in how this boundaryless characteristic affects the professionalism of IT professionals. The increase in the number of career changers into IT might influence the way IT professionals identify themselves, which in turn could lead to a change in the perception of professionalism [see for example: 12, 16].

Finally, our data set was limited to the German context. Career mobility is often subject to geographical or cultural conditions or is influenced by external factors like the current job market [30]. To take these influences into account, we recommend to conduct similar studies in different geographical and cultural contexts, following similar cross-cultural studies in IT workforce research [3, 52].

6 Conclusion

The high turnover and turnaway rates and the high demand for IT professionals make the IT sector a highly dynamic market for human capital. To fill up the shortage of skilled IT workforce technology companies are encouraging the migration of employees without an IT background to the IT sector. In our paper, we therefore examine the different career patterns of employees without an IT background working in IT jobs. Based on the study of 355 German workers we find two categories of career changers into IT: long-term stayers and short-term visitors. Whereas the stayers only make up about a third of the investigated sample, the majority of employees without an IT background move to other sectors after few years in IT jobs. With our study we contribute to a better understanding of the boundaryless IT profession and provide insights into the career mobility of employees without an IT background working in IT jobs.

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Understanding Boundaryless IT Professionals: An Investigation of Personal Characteristics, Career Mobility, and Career Success

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ABSTRACT

Shifts in the evaluation of career success and an increase in boundary-spanning activities in the IT profession pave the way for new career models in IT. Instead of opting for a technical or managerial career in IT, more and more IT professionals follow boundaryless career forms, i.e. IT careers that do not correspond to a horizontal career path but allow career transitions between organizations and sectors. To better understand this trend, we examine three boundaryless IT professional groups—late-entry IT professionals, boomerang IT professionals, and IT leavers. Investigating German socio-economic panel data, we examine their personal characteristics, career mobility patterns, and career success factors. We find a high proportion of IT professionals following boundaryless careers, demonstrating that IT is becoming increasingly open to transition from and to other sectors. We also discuss the high proportion of women in boundaryless IT careers, thus illustrating alternative career paths for women in IT. Finally, we show that boundaryless IT professionals tend to have a higher workload in IT jobs than in non-IT jobs, yet, simultaneously, earn more and exhibit higher life satisfaction. Our study contributes to a better understanding of boundaryless IT careers.

CCS CONCEPTS

• Social and professional topics ~ Professional topics ~ Management of computing and information systems ~ Project and people management ~ Project staffing

KEYWORDS

IT workforce; IT professionals; boundaryless career; career transition; IT experience

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1 Introduction

The career models of the future are becoming increasingly open and flexible both psychologically and physically [37]. Concepts such as the boundaryless career are becoming more and more important, leading to an increase in mobility between organizations as well as professions [11]. As this change transforms the notion of career success [9], further alterations in career models are expected in the future [38].

The trend toward permeable careers in the form of boundaryless career models has taken hold in IT [19, 23]. Depending on their choice of career, IT professionals show a high willingness to switch between organizations and even between professions [23]. Because of the high turnover and turnaway rates, IT professionals who leave not only their employer but also their profession are a much-studied phenomenon in information systems (IS) research [4, 22, 24]. While IT professionals leaving an organization or the IT sector for another sector have recently gained much attention [12, 22], other professional groups following boundaryless careers—late-entry IT professionals and boomerang IT professionals—are only rarely investigated [27, 32]. With this study, we aim to generate a better understanding of the different types of boundaryless IT careers.

Using career sequences of a German socio-economic panel dataset, we investigate three different types of boundaryless IT careers and demonstrate their similarities and differences. Accordingly, our paper confronts the following research questions:

- *What do different types of boundaryless IT careers look like?*
- *How do different types of boundaryless IT careers differ in terms of career mobility, personal characteristics, and career success?*

In our study we adopt an exploratory approach that we hope will generate new knowledge about the boundaryless IT

profession and derive implications for the future advancement of boundaryless careers in IT. In the following we describe the theoretical background of the boundaryless IT profession.

2 Theoretical Background

In the following, we explain the concept of boundaryless careers, introduce different career transitions therein, and define the characteristics of the boundaryless IT profession.

2.1 Boundaryless Careers

Boundaryless career concepts have become popular over the last few decades among researchers for their relevance to contemporary work life, which is characterized by uncertainty and mobility [34]. The concept of the boundaryless career was first described by Arthur [8] who defined it as a sequence of job opportunities that go beyond the boundaries of any single employment setting. This career model was developed in contrast to traditional organizational careers in which individuals were bound to their jobs or employers, meaning that they experienced limited mobility over their whole career [10]. However, as career advancement at a single employer no longer represents modern employment, more employees plan their careers with a boundaryless mindset, meaning that they follow principles such as career movement across the boundaries of employers and occupations instead of following traditional organizational boundaries and advancement [8]. Thus, a boundaryless career orientation can be summarized as a mindset that considers both physical and psychological mobility [37] and emphasizes pursuing external opportunities to overcome organizational and occupational boundaries.

2.2 Career Transitions Within Boundaryless Careers

In the following, we describe various types of career transitions associated with a boundaryless mindset.

Turnaway Transition

Career transitions are described as changes when employees leave their employer (turnover) and/or their profession (turnaway) [21, 22]. Whereas traditional careers follow turnover (moving from one organization to another in the same field), the boundaryless career model promotes more career mobility both inside and outside of the profession [34]. Since the IT industry has unusually high turnover and turnaway rates [21], many IT workforce papers deal with IT professionals leaving both their employers and the IT sector and their reasons for doing so [4, 13, 21]. Researchers suggest that this high turnover and turnaway rate is due to a combination of a high number of job alternatives and the high demands of IT, which can lead to negative consequences such as career exhaustion or burnout [4, 31]. This affects women in particular, as they suffer from additional stresses such as work–family conflict and therefore leave IT [2, 5, 33]. As a result, IT professionals are more willing to leave their organization but also their profession.

Late-Entry Transition

Research papers on career transition mostly focus on leaving a former employer or sector [12, 22]. In contrast, there is little literature on the study of lateral entrants—individuals who enter a new occupation without prior formal education or work experience in that occupation. The limited research on this occupational group indicates an increased need for onboarding as they do not offer specific human capital, which might make this group less attractive to employers [14, 25]. However, current research in the IT sector demonstrates that there are indeed IT professionals that enter the IT profession relatively late after spending much of their careers outside of it [23, 32]. However, these studies also suggest that IT professionals without an IT background often migrate back to their profession of origin [32].Thus, the following question arises for companies: To what extent do lateral entrants help tackle the shortage of IT professionals and in which jobs can they best contribute their knowledge from outside of the industry?

Boomerang Transition

Boomerang employees are, by definition, employees who leave a company/sector but later return [39]. In the boundaryless career research context, we define boomerang IT employees as individuals who leave the IT profession and then return. Unlike leavers, who frequently quit due to dissatisfaction, boomerang employees often decide to quit due to positive, jarring events in their lives (so-called shocks), such as alternative job offers [35]. This type of exit without negative feelings paves the way for subsequent re-entry into the company or sector. Boomerang employees are valuable because they bring important specific knowledge and consequently require less onboarding, making them profitable more quickly for companies [26]. However, recent research on boomerang employees shows that their performance over time is not necessarily superior to external hires or internal promotions [7]. Boomerang employees also have an increased risk of leaving the company for the same reasons that led to their initial termination [7]. The benefits and drawbacks of hiring boomerang employees must therefore be well-considered by companies.

2.3 IT as a Boundaryless Profession

Research on IT career paths hints at boundaryless characteristics in IT careers [19]. IT professionals often move across organizational and occupational boundaries to different functional areas within a firm or other organizations that offer more growth potential [21]. This transformation to a boundaryless IT profession has become possible due to two factors [23]. First, IT use is becoming more frequent in other business functions, which has increased the value of IT skills in non-IT jobs and makes it easier to transition from IT to non-IT positions [23]. Second, the participation of non-IT personnel in the IT labor market is on the rise as computing fundamentals have become integral to college curricula for non-IT disciplines [30]. This could

pave the way for the easier entry of employees without an IT background into IT professions [32].

With the increase in young IT professionals and their changing career aspirations, an increase in boundaryless careers should be expected. Thus, it is essential to better understand boundaryless career transitions in IT to provide career paths that fit the needs of IT professionals who choose not to remain within organizational and professional boundaries. Therefore, we investigate careers in IT that involve career transitions between professions (leaving, entering or multiple transitions) and demonstrate their similarities and differences in career mobility, personal characteristics, and career success. In the following, we describe our exploratory approach using a German Socio-Economic panel survey.

3 Research Methods

To generate an improved understanding of boundaryless IT careers, we chose an exploratory method following research on IT career paths by Joseph, et al. [23]. We examine boundaryless careers and their characteristics using a longitudinal survey of private households across Germany [17]. In the following, we describe both the dataset and the data analysis in more detail.

3.1 Dataset

This analysis of the boundaryless IT career paths is based on a longitudinal panel dataset of the population in Germany namely the Socio-Economic Panel (SOEP) [17]. The dataset covers information on nearly 15,000 households and over 25,000 individuals, aiming at representing Germany's resident population. The panel is one of the biggest multi-disciplinary panel studies worldwide. The household based study started in 1984 and is conducted annually since then. The same adult household members get reinterviewed every year, covering topics such as work and employment, income, health and satisfaction. The goal of the study is to explore well-being in Germany's population as well as long-time societal changes and thus provides the foundation for studies of the development of individuals and households. Due to the rich data on work and employment in the dataset, the SOEP is suitable for investigating career sequences over time [16].

3.2 Data Analysis

To investigate boundaryless careers in IT, we followed previous research on IT career patterns [23]. First, we performed occupational coding, meaning that for each individual in the dataset, we considered which occupation he/she mainly pursued in a calendar year. For coding, we followed the template of Joseph, et al. [23]. Table 1 provides an overview of the coding scheme and a description of the different codes. The codes represent various job fields such as non-IT managerial ("G"), technical administration and support ("J"), and sales ("S") jobs. Jobs belonging to the technical IT ("I") and managerial IT ("M") categories were labeled as IT jobs and all others were labeled as non-IT.

Table 1: Job Codes and Examples (based on Joseph et al. (2012))

Code	Description	Example	Category
I	Technical IT job	software engineer	IT job
M	Managerial IT job	IT project manager	IT job
C	Clerical job	clerk	Non-IT
G	Non-IT managerial job	manager	Non-IT
J	Technical administration job	computer equipment operator	Non-IT
O	Craft, production and service job	service worker	Non-IT
P	Non-IT professional job	accountant	Non-IT
S	Sales job	retail salesperson	Non-IT
T	Technician	healthcare technician	Non-IT
U	Enrolled in school or unemployed	-	-

We then lined up the jobs chronologically to create career sequences [1] that illustrate the course of a career over time. To analyze only relevant career sequences, we then narrowed down the dataset. In our dataset, we only included individuals at least 18 years old that had worked in IT for at least one year during their career. This resulted in a dataset of 1,595 individuals, from which we then drew the different forms of boundaryless IT careers we explain in the next chapter.

After assigning individuals to their career groups, we examined data covering the research questions: differences in career mobility, personal characteristics, and career success factors. As we were working with publicly available data, we relied on information that was available to us in the data set. First, we examined the distribution of jobs between different forms of boundaryless IT careers (see Table 2), then we examined the distribution of demographic data (gender, marital status, major; see Table 3), and finally we compared differences in IT and non-IT jobs in terms of life satisfaction, working hours and gross income (Table 4). To determine the significance level of differences between the groups, we used chi-square test and ANOVA.

3.3 Different Forms of Boundaryless Careers in the Sample

For our study, we consider boundaryless careers in IT as careers that include at least three years of work experience in an IT job and involve at least one transition between fields. This

transition can be moving from outside IT into IT (late-entry IT professionals), moving from IT into another sector (IT leavers), or moving multiple times between sectors (boomerang IT professionals). In the following, we describe these groups in detail.

Late-Entry IT Professionals

The late-entry IT professionals group consists of individuals who started their career working in a non-IT job but then switched to an IT job at some point in their careers. For this group, a three-year threshold is set for work experience in a non-IT industry before switching to an IT job. This group has a sample size of **352** unique individuals.

Boomerang IT Professionals

This group consists of individuals who started their careers in IT, left IT at a later point to work in a non-IT-related field, and then decided to switch back to the IT industry. This group has a sample size of **101** unique individuals.

IT Leavers

This group consists of IT professionals who have worked in IT for at least 3 years but decided to leave the IT sector and then never returned (turnaway). This group has a sample size of **141** unique individuals.

Control group: Forever IT

This group consists of professionals who have spent their entire career in IT, meaning that they have always held a profession in I or M occupational groups (see Table 1). We do not formally count this group as boundaryless IT professionals, however, they serve as a control group. This group has a sample size of **255** unique individuals.

4 Results

To better understand boundaryless career paths in IT, we examined their career mobility, personal characteristics, and career success factors. In doing so, we investigated three forms of boundaryless IT professionals (late-entry IT professionals, boomerang IT professionals, and IT leavers) and compared them with IT professionals who never left the IT field (Forever IT). In the following, we discuss the career mobility, personal characteristics, and career success of boundaryless IT professionals.

4.1 Career Mobility

First, we examined the career sequences of the professional groups and determined in which occupations the groups spent most of their time. Table 2 shows the job distribution of the various groups. In the following, we address each form of boundaryless career individually and explain its career mobility.

Table 2: Job Distribution of Boundaryless IT Careers (based on Joseph et al. (2012))

Job		Forever IT (control group)	Late-Entry IT Professionals	Boomerang IT Professionals	IT Leavers
	Sample	**255**	**352**	**101**	**141**
Technical IT	**I**	82.1%	23.1%	52.8%	31.7%
Managerial IT	**M**	4.5%	1.8%	5.8%	2.6%
Non-IT Manager	**G**	-	6.1%	4.6%	4.9%
Non-IT Professional	**P**	-	16.4%	13.5%	13.7%
Clerical	**C**	-	7.6%	1.7%	6.9%
Technical Admin. and Support	**J**	-	0.5%	0.2%	0.6%
Craft, Production, and Service	**O**	-	11.5%	2.4%	7.6%
Technicians	**T**	-	16.8%	9.3%	16.3%
Unemployed/School	**U**	13.4%	16.3%	9.6%	15.8%
Sequence Length (Years)	**Mean**	8.1	16.8	12.1	16.2
	SD	5.6	8.0	6.6	8.7

Late-Entry IT Professionals

This sample consists of 352 unique individuals who worked in non-IT jobs for at least 3 years before joining the IT field. Naturally, among all of the observed groups, this one has the highest participation in non-IT professions (75.1%). Only a few late-entry IT professionals hold IT management positions (1.8%), most spend their time in IT in technical IT jobs (23.1%). To better understand the fields from which late-entry IT professionals come from, we classified the jobs held by the individuals 3 years prior to joining IT. We found a high portion of the sample that was unemployed or enrolled in school prior to joining IT (22.6%). Furthermore, late-entry IT professionals mainly switched from (T) Technician (22.2%), (P) Non-IT Professional (19.6%) and (O) Craft (17.3%) jobs

Boomerang IT Professionals

The sample of boomerang IT professionals consists of 101 unique individuals who started working in IT, switched to a non-IT job, and after spending some time there, switched back to an IT job. A major part of this group worked in technical IT jobs (52.8%). We also observed that this group has the highest participation in managerial IT positions (5.8%) among all groups. This finding is probably attributed to moves away from IT in which individuals gained more experience by working in a non-IT job that might be useful for their later switch back to IT. This group also had a significantly lower unemployment rate (9.6%) than every other group.

Having a closer look at boomerang IT professionals, we were especially interested in discovering the details of their career histories. The data show that the average length of time before boomerang IT professionals initially left the IT sector was 3.4 years. The data furthermore indicate that boomerang IT professionals mainly left the IT sector for (P) Non-IT Professional Jobs (44.90%) (T) Technician jobs (25.51%) or (G) Non-IT Managerial jobs (16.33%). Furthermore, we observed that 30 of the 101 (29.7%) individuals returned to IT to work as IT managers.

IT Leavers

Finally, we examined IT leavers. This group worked in IT for at least 3 years before leaving IT and never returned. People in this group are characterized by spending most of their time in technical IT jobs (31.7%) before moving to similar occupations such as (T) Technicians (16.3%) or (P) Non-IT Professionals (13.7%). However, individuals who were in a managerial IT position seem to be less likely to move out of IT. IT managerial jobs only comprise 2.6% of the jobs of IT leavers, indicating that there are few IT leavers that exit the IT sector after having a managerial IT position.

Table 3: Personal Characteristics of Boundaryless IT Professionals

		Forever IT (control group)	Late-Entry IT Professionals	Boomerang IT Professionals	IT Leavers	χ^2
	Sample	**255**	**352**	**101**	**141**	
Gender	Male	91.1%	77.7%	76.8%	77.5%	21.38*** (d = 3)
	Female	8.9%	22.3%	23.2%	22.5%	
Marital status	Married	66.2%	50.6%	63.4%	63.4%	38.03*** (d = 3)
	Unmarried	33.8%	49.4%	36.6%	36.6%	
Major	IT	43.9%	11.8%	38.6%	24.2%	87.67*** (d = 3)
	Non-IT	56.1%	88.2%	61.4%	75.8%	

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

4.2 Personal Characteristics

After examining the career mobility of boundaryless IT professionals, we investigated their personal characteristics. Table 3 provides an overview of the sample's gender, duration of stay in IT, marital status, and education.

In terms of gender, the results show that the IT profession is still predominantly male. However, the employees who pursue boundaryless careers have a significantly higher proportion of women (22.3%–23.2%) than the forever IT group (8.9%). Thus, the data show that more women in IT pursue boundaryless career models. Furthermore, we found a significant lower proportion of married, boundaryless IT professionals (50.6%–63.4%) compared to IT professionals who have never left IT (66.2%).

Finally, our research shows that the share of IT professionals having a major in IT is low. Naturally, IT professionals staying in IT have the highest share of an IT major education with 43.9%. The group of late-entry IT professionals has the lowest share of an IT major education with 11.8%. This also means that 11.8% of late-entry IT professionals had an education in the IT sector but started working in another sector after their education

4.3 Career Success Factors

Finally, we assessed three factors of career success—life satisfaction, working hours, and gross income—and investigated the similarities and differences. To better identify the differences between IT jobs and non-IT jobs, we examined the career success factors for the time spent in IT jobs vs. non-IT jobs. Table 4 provides an overview of the factors.

First, we compared the overall life satisfaction of all three types of groups and distinguished between their satisfaction while working in IT and non-IT jobs. We can see that the forever IT, late-entry IT professionals, and boomerang IT professionals are generally happier in IT jobs. The only ones who reported higher satisfaction in non-IT jobs are IT leavers, which proves them right in their decision to leave IT. The differences between the groups diverge significantly

Table 4: Career Success Factors of Boundaryless IT Professionals [1]

		Forever IT (control group)	Late-Entry IT Professionals	Boomerang IT professionals	IT Leavers	F-Test between groups
Life Satisfaction Scale: 0–10, 0 = Very Bad, 10 = Very Good	**IT jobs (SD)**	7.46 (1.45)	7.28 (1.40)	7.44 (1.40)	7.21 (1.48)	7.35***
	Non-IT jobs (SD)	-	7.22 (1.62)	6.97 (1.74)	7.26 (1.52)	9.78***
	F-Test within group	-	1.58	27.21***	0.50	
Working hours (per week)	**IT jobs (SD)**	42.7 (8.05)	42.68 (8.86)	43.18 (10.44)	41.97 (9.50)	2.88*
	Non-IT jobs (SD)	-	41.35 (10.95)	42.22 (13.66)	41.22 (9.58)	2.21
	F-Test within group	-	17.45***	1.93	2.81	
Gross Income (Euros per month)	**IT jobs (SD)**	4524.93 (2250.24)	4130.54 (2956.10)	4441.27 (1923.70)	3812.04 (2170.62)	20.49***
	Non-IT jobs	-	3412.85 (2482.02)	4275.94 (1839.36)	3677.00 (2147.78)	46.34***
	F-Test within group	-	82.38***	2.30	1.79	

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

[1] Please be aware that to calculate the F-test, we used the number of years spent in IT/outside of IT per group, for which the information was available. The years we used are as follows: Forever IT: 1,765 years in IT jobs, 0 in Non-IT jobs; Late-Entry IT Professionals: 1,431 years in IT jobs, 4,473 years in Non-IT jobs; Boomerang Employees: 701 years in IT jobs, 516 years in Non-IT jobs, IT Leavers: IT jobs 760 years, Non-IT jobs 1,140 years.

Next, we compared the working hours in IT and in non-IT jobs. It is noticeable that all groups worked more hours at IT jobs, which confirms the higher workload in IT. Boomerang IT professionals had particularly high workload, which is consistent with their high share of managerial positions. We could not find significant differences between the groups, however we found a significant higher workload for late-entry IT professionals in their IT jobs compared to their non-IT jobs (F-Test=17.45***).

Finally, we examined the monthly incomes of the groups. All groups earned more in IT jobs (see for example the group of late-entry IT professionals: €3,412 vs. € 4,130). Also notable is the group of IT leavers, who already earned the least in IT jobs (mean = €3,812) and subsequently earned even less (mean = €3,677). Since they did not work significantly fewer hours but earned significantly less money in IT jobs than other groups, compensation could be a major motivator for leaving the IT sector.

5 Discussion

Our study was motivated by our desire to generate a better understanding of the boundaryless IT profession. We therefore investigated three different forms of boundaryless careers in the IT context: late-entry IT professionals, boomerang IT professionals, and IT leavers. To develop a better understanding of these specific career groups, we compared their career mobility, personal characteristics, and career success factors. Our results show that boundaryless career types account for a high proportion of careers in IT and thus extend previous studies on the boundaryless IT profession [19, 23]. We also identify a significantly higher proportion of women pursuing boundaryless career paths in IT. This finding supports previous management research that has demonstrated that more women than men follow boundaryless career paths [20, 28]. Finally, our study indicates higher career success for boundaryless IT professionals in their IT jobs than in their non-IT jobs. The study shows that although boundaryless IT professionals are required to work longer hours in IT, they are also better paid and have higher life satisfaction when working in IT jobs (except for IT leavers). In the following, we discuss these points in detail and point out the limitations and future directions of our study.

5.1 IT as a Boundaryless Profession

Our study contributes to a better understanding of boundaryless career paths in IT. While previous research has described the IT profession as boundaryless [19] but simultaneously focused mainly on leaving the IT sector [12, 22], our study also considers other forms of boundaryless IT careers. Since boundaryless careers will become increasingly important in the future as career opportunities increase [18], it is crucial for IT companies to generate a good understanding of boundaryless career models and how to embed employees pursuing boundaryless IT careers.

Through our study, we aimed to generate a better understanding of the presence of late-entry IT professionals in the IT sector and the extent to which they are suitable for combating the IT skills shortage. Whereas late-entry IT professionals may need a high amount of upfront investment due to their lack of specific human capital [14], they possess expertise from outside of the sector that can be of particular importance for boundary-spanning activities. Our study shows that a high proportion of late-entry IT professionals moves to IT after a period of unemployment, which could indicate a switch due to the attractive job security in the IT sector. Furthermore, the results show that the switch is particularly successful from similar professions such as technical jobs. Thus, technicians but also employees with other, similar background seem to be particularly suitable for being employed in the IT sector.

With this study we also contribute to a better understanding of boomerang IT professionals in IT [27]. Boomerang IT professionals might be of special value for IT companies, as they—in contrast to lateral entrants—bring knowledge relevant to the field and possess valuable knowledge unrelated to the branch [26]. Our study shows that these boomerang IT careers do occur and can be successfully pursued. Due to the high number of working hours, the relatively high pay, and the high proportion of IT majors in this sample, we suspect that this group is comprised of higher-ranking IT professionals in consulting and management positions, who greatly benefit from their experience outside the IT sector.

5.2 Boundaryless IT Careers as a Chance for Women

Prior research on boundaryless careers shows that women, in particular, follow this form of self-directed career since they leave their profession, either long term or temporarily, more often than men due to family reasons [20, 28]. Our analysis shows that this pattern also holds true for the IT profession. In their analyses of career paths in IT, Joseph, et al. [23] found a higher proportion of women pursuing boundaryless career paths in the IT sector. This is especially evident in the high turnaway rate of women in IT [6, 40]. Numerous studies in IT workforce research deal with the challenges of women in the IT sector and discovered problems with career advancement, incompatibility with family, or high work demands as reasons for women leaving the IT sector [2].

With our research, we would like to present an alternative career path for women in IT. While the high share of female leavers has already attracted much research interest, our research shows that a significant share of late-entry IT professionals (22.3%) and boomerang IT professionals (23.2%) are female. We conclude that late-entry as well as boomerang careers seem to be a promising way for women to work in the IT sector and thus, to our knowledge, we are the first researchers to focus on female late-entry and boomerang IT professionals. With this study, we would therefore like to strongly encourage research on boundaryless careers of women in IT to highlight alternative career paths in IT for women

5.3 Career Success for Boundaryless IT Professionals

Our study was intended to provide insights into career success factors for boundaryless IT professionals. We found it particularly

interesting that although both late-entry and boomerang IT professionals have a higher workload in IT jobs (~1 hour per week on average), both groups have a higher level of life satisfaction while working at an IT job. This contributes to and validates previous research on the high demands of IT by supporting existing studies on its high workload [3, 29]. However, we demonstrate that this higher workload is not necessarily accompanied by lower job dissatisfaction. Despite this increased workload, boundaryless workers seem to be generally more satisfied in IT jobs (except IT leavers). This may likely be related to the better pay in IT. Following previous research on compensation in IT [36], our results indicate the good payment in IT jobs, as all occupational groups had higher earnings in IT jobs than in non-IT jobs. This finding suggests that the re-entry of boomerang IT professionals and entry of late-entry IT professionals into IT pays off financially. Nevertheless, it also illustrates that IT leavers are willing to accept a drop in pay to leave IT.

5.4 Practical Contribution

Our study on the boundaryless IT profession has implications for (potential) IT professionals as well as their employers. IT professionals, or those who want to become one, may learn through our study that a switch out of and into IT is not unusual. For IT professionals who aspire to follow this type of career, it is therefore important to build up an interdisciplinary skillset. This is especially true for late-entry IT professionals who have completed training outside of IT before joining IT. This training should develop a diverse spectrum of skills so that these candidates can then distinguish themselves from specialized IT staff and use their interdisciplinary knowledge to their advantage.

For employers, our study indicates that the IT profession covers a wide range of career types. Companies hiring IT professionals could therefore benefit from loosening the job requirements. In addition to the typical, technical IT jobs, many IT positions nowadays require interdisciplinary expertise due to their boundary-spanning activities, which speaks directly to the skill set of late-entry and boomerang IT professionals.

5.5 Limitations

To interpret our results correctly, we would like to draw attention to the limitations of our research. First, we use a publicly available dataset and therefore rely on self-reporting from survey participants. This implies that the data set was partly incomplete if individuals were not willing to provide information on, for example, life satisfaction or salary. All information was provided voluntarily and we therefore had to rely on the willingness of the survey participants to provide the information (correctly).

One drawback of these publicly available data sets, and also of our classification of groups, is the resulting, potential variation across career types. For example, we see wide variation in average career lengths. Because of the shorter career length of the "Forever IT" control group, this data must be interpreted differently compared to other careers with longer career sequences. For example, individuals in Forever IT may be at the beginning of their careers. To address these variations in future, the data set could be limited to a minimum length of career years or only careers with a pre-set career length could be considered (see [32]).

Second, we point out that the dataset is subject to a specific context. Since we know that career mobility depends on cultural and geographical context [15], we would like to point out that the careers in our dataset could be subject to German cultural as well as labor law conditions. For example, job security due to labor regulations (i.e., notice period, protection against dismissal, etc.) might have influenced career behavior. We would therefore like to encourage research in other cultural and geographical contexts.

5.6 Future Research

We consider our study a contribution to the vital research on the different forms of the boundaryless IT profession. As the shares of boundaryless career paths are expected to increase in the future [18], we call for further research on boundaryless IT careers. In particular, we want to highlight research on late-entry IT professionals. Since we recognize that only a small proportion of employees without an IT background remain in IT for the long term [32], we call for in-depth research on late-entry IT professionals, their motivations for moving into IT, and their challenges in making the transition. A better understanding of late-entry IT professionals' motivation in entering IT can lead to a more successful transition of such professionals into IT. In addition, we want to encourage future research on boomerang careers in IT [27]. Boomerang IT professionals who return to IT with them external knowledge that can be particularly valuable to IT companies [39]. Therefore, research on successful boomerang IT professionals may be vital for improving the knowledge about human capital in IT. Ultimately, we would like to call for more research on women in boundaryless careers. Since women pursue a significantly higher share of boundaryless careers [20, 28], their career paths, challenges, and reasons for career transition are particularly interesting to explore and can provide better insight about women in IT.

6 Conclusions

With a new generation of IT professionals and their changing perceptions of career design, the importance of boundaryless IT careers continues to grow. Understanding different forms of this type of career design will be crucial in the future for companies that want to develop their IT employees. Our study of late-entry IT professionals, boomerang IT professionals, and IT leavers reveals the differences and similarities in their personal characteristics, career mobility, and career success. We find a high percentage of IT professionals in boundaryless careers, suggesting that the IT sector is becoming more open to career transitions. We discuss the high percentage of women in boundaryless IT careers, indicating one way that women are participating in IT jobs. Finally, we demonstrate that boundaryless IT professionals typically work more hours in IT jobs than non-IT jobs while enjoying higher earnings. Our study provides a more in-depth understanding of boundaryless IT careers.

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