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IT Corporate Entrepreneurship – Identifying Factors for IT Innovations in Non-IT Companies

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IT Corporate Entrepreneurship – Identifying Factors for IT Innovations in Non-IT Companies

Dissertation

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vorgelegt von

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Preface

IT enabled innovations are one of the upcoming trends in the IS research community. To adapt to the associated changes, firms must develop a strategy that helps overcome the conventional role of IT. Even traditional industries undergo a shift in their innovation strategies, seen, e.g., in the energy sector, whose transformation is fostered by new technologies, such as smart networks to better predict maintenance and improve grid management. IT thus becomes a major element of the firm's innovation process. Accordingly, managers must adjust their leadership strategies to transform their departments to innovation drivers. This cumulative thesis aims to understand the important factors of employees´ innovation intention to help managers create innovative climates within their departments.

This thesis would not have been successful without the help of many supporters.

First, I want to thank Prof. Dr. Lutz Kolbe for giving me the opportunity to start this thesis. Without his encouragement, positive spirit, and motivation, I would not have completed this work. Furthermore, I want to thank Prof. Dr. Johann Kranz for his guidance and support for the majority of this thesis. His initial push and continual striving for perfection helped me throughout the process. Moreover, I want to thank Prof. Dr. Jan Muntermann for his great seminar "Engaged Scholarship," which provided me with a deeper understanding of the spirit of research. In addition, his questions helped me to focus on the important topics for this work.

I would particularly like to thank Sebastian Busse, who invested much time into persuading me to undertake this thesis. Without him, I would never have started.

A special thanks goes to my colleagues at the Chair of Information Management – Andre Hanelt, Benjamin Brauer, Björn Hildebrandt, Carolin Ebermann, Everlin Piccinini, Ilja Nastjuk, Johannes Schmidt, Matthias Eisel, Nicky Opitz, Patrick Urbanke, Sebastian Zander, Simon Trang (thank you for being my mentor and putting in so many hours to help me understand PLS!), Thierry Ruch, Tobias Langkau, Vujdan El Khatib – who always supported me and encouraged me in hard times! You are great! A special thanks also goes to Rachael Garcia. With her proofreading, which was often mentioned positively in reviews, she helped immensely to improve this work! Thank you so much for investing considerable time and for your quick responses when deadlines were so close.

Furthermore, I want to thank my father, who has supported me in every step of life. He has made me who I am today. I also want to thank my family for providing the backing I needed. A special thanks goes to Anna, Ulrike, Jens, and Kai Barelmann, who always believed in me and gave me mutual understanding. Finally, I want to thank all of my friends who helped me get out and clear my head, always leaving me more focused afterwards.

Göttingen, April 2016 *Henning Krüp*

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Acronyms

AMCIS	Americas Conference on Information Systems
AVE	Average Variance Extracted
BEV	Battery Electric Vehicle
CA	Cronbach's Alpha
CR	Composite Construct Reliability
ECIS	European Conference on Information Systems
EV	Electric Vehicle
HICSS	Hawaii International Conference on System Sciences
ICIS	International Conference on Information Systems
IS	Information Systems
IT	Information Technology
OIT	Organismic Integration Theory
PACIS	Pacific Asia Conference on Information Systems
PBC	Perceived behavioral control
PLOC	Perceived Locus of Causality
PLS	Partial Least Squares
SCT	Social Cognitive Theory
SDT	Self-Determination Theory
SEM	Structural Equation Modelling
SME	Small and Medium-Sized Enterprises
VHB	Verband der Hochschullehrer für Betriebswirtschaft e.V.

A Foundation

The first chapter of this cumulative dissertation is divided into five parts. It starts with insights into the field of IT innovation, explaining the motivation for this work and the role of IT in the innovation process of non-IT companies. The second part (A.2) presents the major research questions. Afterwards, Section A.3 describes the structure and overview of the studies included in this thesis, while Section A.4 explains the research design. Finally, the anticipated contribution is specified in Section A.5.

1 Motivation

Today's IT departments are undergoing a fundamental shift from acting as business-supporting units towards being drivers of innovation (Westermann et. al., 2014). For most IT departments, this means that business managers have a different expectation of their IT department's work than in previous decades. The original role of providing data or increasing the efficiency of existing processes (Guillemette and Paré, 2012) has become a major contributor to the innovation process (Melville et al., 2004). As firms constantly face global competition to be innovative, they are pressed to focus on corporate entrepreneurship (CE), which has a positive influence on innovation performance (Covin and Sievin, 1991). As a result, CE is garnering more attention in the area of innovation and management research (e.g., Carsrud and Brännback, 2011; Habtay, 2012). The special issue of the MISQ "Information Technology and Innovation" underlines the importance of that topic for the IS community as well. The challenge for firms is to integrate new digital technologies and IS components into non-IT goods to raise the value of their products (Nambisan, 2013). Even traditional industries like energy providers will have to address this challenge. Cyber physical systems – an integration of sensor and actuator networks into the physical grid – enable providers to predict maintenance and thereby improve their grid management. These new opportunities lead to new management strategies. For example, Volkswagen has also already started cooperation with leading IT companies Google and Apple (Volkswagen, 2014). These strategic alliances highlight the importance of traditional industries collaborating with the IT sector when internal IT is unable to develop the necessary innovations. Besides these changes, firms are challenged by consumerization (Gregory et al., 2014), the phenomenon of consumers bringing their technologies and expectations to the workplace (Ruch and Gregory, 2014), which turns the direction of innovation upside down. Today, innovation emerges from the private use of technology (Niehaves et al., 2012) and corporate IT is in danger of being dropped from the innovation process if they cannot fulfill these expectations (Gregory et al., 2014). In this case, business managers will collaborate with external partners and find a way around corporate IT (Niehaves et al., 2012). This dependence on external partners in such an important process as innovation is particularly dangerous. To avoid those dependencies, IT departments must transform their role from functioning as an operand resource to being an operant resource that triggers innovation (Nambisan, 2013). To create innovations in such

an interconnected environment, IT managers need to redefine their employees' focus towards a more innovative behavior (Leidner et al., 2010; Watts and Henderson, 2006). They must also create a company environment that allows employees to be innovative, as innovations come from the "machine rooms" of organizations, from each individual at the operational level (Kuratko and Audresch, 2009). Furthermore, internal IT departments should leave their familiar terrain and open up their innovation channels to the environment, e.g., customers and partners (Yoo et al., 2012). Concepts like open innovation (Chesbrough, 2003) are widely used in other areas of the company; IT must adopt these concepts to gain knowledge and new ideas from the external environment (Dahlander and Gann, 2010).

The goal of this thesis is to provide deeper insights into the field of IT innovation in non-IT companies. Practitioners like CIOs and middle managers of IT departments should be guided to choose the appropriate style of leadership to create an innovation environment for their employees. At the same time, further research should be supported by evaluating three research models presented in part B and shedding light onto the field of innovation in in-house IT departments. As this cumulative thesis sees itself as a starting point into the field of IT corporate entrepreneurship, it will design the path for further research in this field.

2 Research Questions

The innovativeness of IT departments is crucial not only for IT companies like Google or Apple but also for traditional industries, such as the automotive sector or energy suppliers. While IT technologies have been embedded in an increasingly wide range of products (Yoo et al., 2010), the path to innovation has changed in the last few years. Management innovation (Birkinshaw et al., 2008) as well as disruptive business models use new digital technologies to reduce the complexity of, e.g., communication with potential sources of innovation (Johnson et al., 2008). This is very important for concepts like open innovation, which build upon the exchange between a company and external partners (e.g., customers or vendors) (Chesbrough, 2003). Lichtenthaler (2011) defines open innovation as "[…] systematically performing knowledge exploration, retention, and exploitation inside and outside an organization's boundaries throughout the innovation process." This process of exchange can be supported by the use of social media and other parts of the Web 2.0, leading to a faster development of new ideas and products. Besides external influences,

new developments in the area of digital components, e.g., smaller sensors for wearables, lead to new opportunities and help add more digital value to products that were previously unconnected to the digital world (Woodard et al., 2013).

Kuratko and Audresch (2009) maintain that innovation comes from the operational level of a company. Therefore, managers must create an innovative environment that allows non-managing employees to be creative (Leidner et al., 2010; Watts and Henderson, 2006). Managers should motivate their employees to acquire new knowledge and experiment with new ideas (Floyd and Lane, 2000). This thesis addresses the lack of research regarding whether extrinsic motivation can be induced top-down to positively influence entrepreneurial intention (Wales et al., 2011). Accordingly, the first research question is derived as follows:

> *RQ1: Can extrinsic motivation influence IT employees' endogenous motivation towards a more entrepreneurial intention?*

The changing role of IT in the business context does not only belong to technical innovations and the upcoming consumerization of IT; it also concerns corporate IT, which risks being left behind in this competition (Gregory et al., 2014). In this case, business managers might collaborate with external partners and develop innovations without involving their own IT employees (Niehaves et al., 2012). For internal IT this means facing the challenge of opening up to external partners, e.g., outsourcing partners or customers, and starting to collaborate with them. It is important that IT departments acquire the right knowledge at the right time, applying it and consolidating any necessary information for future use. Identifying and transferring knowledge from distant sources will be particularly challenging, as this is a complex task (Salge et al., 2012). However, open innovation introduced by Chesbrough (2003) might be the key for mastering this serious challenge. Managers must develop a strategy to anchor concepts, such as knowledge sourcing (Dahlander and Gann, 2010), thus creating the environment necessary for their employees to work innovatively. While the positive effect on the outcome and innovation process has already been verified for other industries (Davey et al., 2010), empirical evidence of the role of external innovation collaboration and openness in the context of business IT is lacking, along with research on the role of the individual level in this process (Kinnamon and Fabian, 2010). Therefore, RQ 2 is posed as follows:

RQ2: What is the influence of openness and absorptive capacity on IT entrepreneurship?

Alongside the key role of customers in the process of open innovation (Prahalad and Krishnan, 2008; Sawhney et al., 2005), IT outsourcing partners can be a source of knowledge for innovations. Because long-term partners (e.g., outsourcing partners) have a deep knowledge and understanding of the core business of their clients, they are able to provide the knowledge needed for innovation, making it easier for their client to adopt it. There are various prerequisites for a good exchange: reciprocity is positively related to the attitude of knowledge sharing (Bock et al., 2005) and the same applies to social interaction ties, which offer the best conditions for information exchange (Yli-Renko et al., 2001). Research question three therefore examines the role of social interaction in the innovation process.

RQ3: *Are social interactions between internal IT employees and the outsourcing partners important in the process of internal innovation?*

Section C deals with a practical application of IT innovation in non-IT industries. Global warming and increasing levels of greenhouse gases in the atmosphere are some of the biggest problems of this century, with risks for both humans as well as their natural surroundings (Mcmichael et al., 2006); environmental sustainability is one way of addressing this challenge. IS research also recognizes this important topic, focusing on its contribution in themes like Green IS and Green by IS (e.g., Watson et al., 2010; Seidel et al., 2013). The transportation sector is responsible for a high proportion of greenhouse gas emissions (Hensher, 2008). Hence, new means of transportation, e.g., battery electric vehicles, can help in the movement towards more sustainable transportation (Eisel and Schmidt, 2014). The diffusion of electric vehicles is still low because customers are reluctant to accept the new technologies due to concerns about their ability to effectively replace conventional vehicles (Eisel and Schmidt, 2014). In this case, IS could play a key role in fostering greater acceptance by supporting users with more information. This could help persuade customers to buy an EV, thereby spreading this sustainable means of transportation. Research question four therefore deals with the role of mobile applications in reducing reservations about EVs and helping to spread the technology.

RQ4: What is the role of mobile applications concerning the disruptive potential of EVs?

3 Structure of the Thesis

This cumulative thesis compromises four parts (see Figure 1). The first and last parts frame four interrelated studies, while the middle section concerns the research questions described in Section A.2. The following figure illustrates the structure of this thesis.

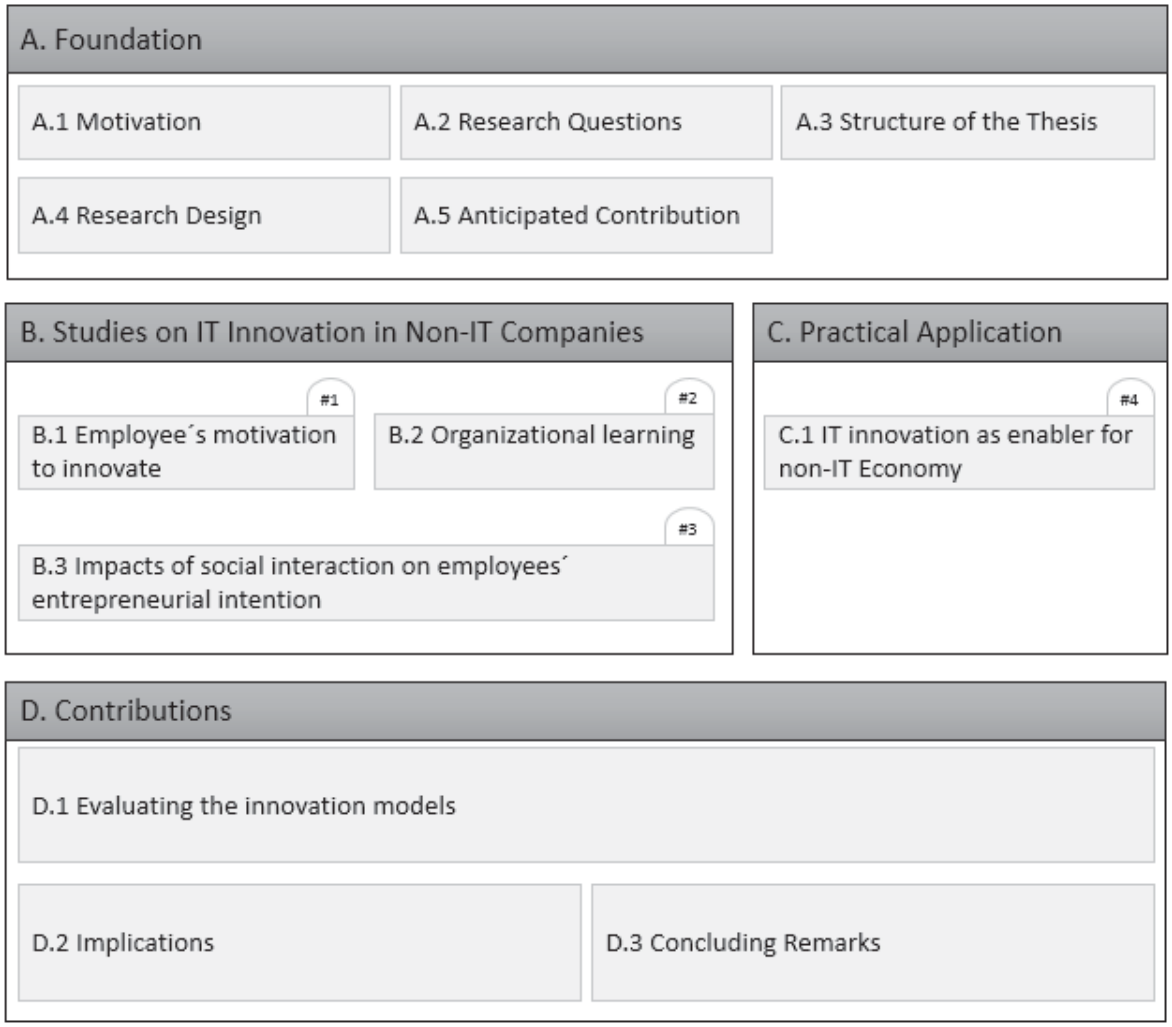

Figure 1 - Structure of this Thesis

Part A starts with the motivation, followed by the four core research questions covered in this thesis. Afterwards, the structure of this work is presented. The chapter concludes with the research design and anticipated contribution.

The publications in Part B form the core of this thesis. These three publications address three of the four core research questions. Section B.1 addresses whether extrinsic motivation can influence the endogenous motivation of IT employees towards a more entrepreneurial intention. The study within examined the influence of job design

constraints, the corporate environment, and contextual motivation on individual entrepreneurial intention. Section B.2 takes a deeper look into the role of openness and absorptive capacity in the context of IT entrepreneurship in non-IT companies. The third research question – regarding the importance of social interactions in the internal innovation process – is covered in B.3, with the study offering insights into the importance of shared goals, social interaction ties, trust, and the norm of reciprocity in the innovation process.

Part C represents a practical application for IT innovations in non-IT industries and covers the last research question: What is the role of mobile applications concerning the disruptive potential of EVs? The study presents attributes that are related to both electric and conventional vehicles. In a second step, app stores were searched to find apps addressing the negative attributes connected with EVs in order to demonstrate their potential impact. All publications in Parts B and C have been published in the leading IS conference proceedings (see Table 1).

The final chapter (Part D) reflects the findings of the studies from Parts B and C and provides a brief overview of the findings regarding the research questions from Section A.2. It also highlights the contribution to research as well as information and guidelines for practitioners. Part D ends with concluding remarks as well as describing the limitations of this cumulative thesis and the need for further research.

No	Outlet	Ranking	Status	Section	Research Question	Contribution
#1	International Conference on Information Systems	A	Published	B1	How can extrinsic motivation influence IT employees' endogenous motivation towards a more innovative intention?	Understanding the role of endogenous motivation in the context of corporate entrepreneurship
#2	European Conference on Information Systems	B	Published	B2	What is the influence of openness and absorptive capacity on IT entrepreneurship?	Understanding the role of openness and organizational learning in the process of innovation
#3	Multikonferenz der Wirtschafts-informatik	D	Published	B3	How important are social interactions between internal IT employees and the outsourcing partners in the process of internal innovation?	Understanding the role of social interaction in the process of innovation behavior
#4	International Conference on Wirtschafts-informatik	C	Published	C1	What is the role of mobile applications concerning the disruptive potential of EVs?	Practical application: IT support to enable disruptive innovations in sustainable mobility

Note: The ranking is based on the VHB Jourqual 3 ranking.

Table 1 - Studies of this Thesis

4 Research Context and Design

In their paper "Exploring IT-enabled innovation: A new paradigm?" in the International Journal of Information Management, Ashurst, Freer, Ekdahl, and Gibbons (2012) call for contributions to investigate how IT can be involved in business innovation. Prior research found evidence that leading companies in the exploitation of IT are surpassing their competitors in the area of innovation, indicating that companies overcome the doubts regarding the ability of IT to contribute to their business innovations. This idea is confirmed by Brynjolfsson (2010), who states, "[…]the way companies implement business processes, organizational change, and IT-driven innovation is what differentiates the leaders from the laggers. Rather than levelling the playing field, IT is actually leading to greater discrepancies." This cumulative thesis contributes to the emerging field of IT-enabled business innovations by evaluating influencing factors on the individual

entrepreneurial intention of IT employees in non-IT companies. In addition, this thesis explores the function of IT managers and the underexplored role of IT as an enabler of innovation, which is the focus of the special issue of the MIS Quarterly (Nambisan, 2014). Therefore, three independent studies are provided, aiming to shed light on various aspects of the innovation intention of individuals within IT departments.

The field of information systems lies at the interface between business administration and computer science. Research in this field differentiates between two types of research paradigms: design science and the behavioral approach. Behavioral science research tries to identify the laws describing how the world works. It validates and develops theories explaining the interaction between tasks, technologies, and humans (Hevner et al., 2004). In contrast, design science seeks to contribute utilities by developing IS artifacts with the goal of provide effectiveness, which results in solutions that can be transferred from research to practice (Wieringa, 2009). This cumulative thesis follows the behavioral paradigm. It should help to create a deeper understanding of the path to innovation, referring to the interaction between technologies, management, and humans (Hevner et al., 2004). From the five research streams of Banker and Kauffmann (2004), this study follows the stream of “IS organization and strategy” (see Table 2). The core section (Parts B and C) mainly uses models and surveys, focusing on the business unit and the individual.

Research Stream	Level of Analysis	Methodologies Used
Decision Support and Design Science	System level, mostly in conjunction with human users or business processes, up to the level of a strategic business unit	Mathematical programming, forecasting, simulation, expert systems
Human–Computer Systems Design	User-focused, involving both individuals and groups	Experiments, argumentation, simulation, system testbeds
Value of Information	Individual decision makers, technologies in business process context, firm actions in market context	Decision trees, analytical models, statistical analysis, mathematical programming, simulation
IS Organization and Strategy	Individuals, groups, business units, organizations, marketplace	Models, case studies, field studies, experiments, surveys, cross-sectional and longitudinal designs, argumentation, blend of qualitative and quantitative methods
Economics of IS and Technology	Spans levels: individual decision makers, business process/ product/project, strategic business unit/firm, industry, market, economy	Analytical modeling, empirical analysis and econometrics, cross-sectional and longitudinal design, experiments, simulation

Table 2 - Five Streams of IS Research (Banker and Kauffmann, 2004)

Besides the research stream and the paradigm, the epistemology choice guides the research. Prior research has defined three classifications of studies: positivist, interpretive, and critical (Chua, 1986). Positivist studies believe that companies have a structure beyond their employees' actions. To verify or falsify empirical testable theories and hypotheses, the positivist researcher uses sample surveys and experiments (Orlikowski and Baroudi, 1991). Interpretative studies instead assume that individuals have an environment that influences them. Thus, the interpretive researcher tries to understand the meanings that participants assign to phenomena. In contrast to the positivist researcher, interpretative researchers reject the idea that there are objective or factual situations that help to understand the phenomena in focus. Hence, interpretative research does not generalize from situations; it aims to understand the phenomenon within the contextual and cultural situation (Orlikowski and Baroudi, 1991). The goal of critical studies is to critique the status quo. They aim to transform restrictive and alienating social conditions by exposing structural contradictions within social systems as well as deep-rooted and fundamental assumptions and convictions (Orlikowski and Baroudi, 1991). This thesis follows the

principals of positivist epistemology with the aim of explaining the relation between individual action and the environment of a company based on large surveys. To explain these phenomena, this cumulative thesis applies a mix of quantitative and qualitative research methodologies from social sciences. Depending on the particular aim of each paper, exploratory and/or explanatory research methods are employed. Part B builds on a rich sample of 354 questionnaires filled out by IT employees in non-IT companies. To guarantee a high quality sample, the questionnaire was distributed by a market research company in English and German in the UK and Germany. Various quantitative research methods, such as structural equation modeling and mediation analysis, were used to evaluate the survey (Ringle et al., 2005).

In Part C, a rich sample of 1461 participants was involved to test theories providing deep insights into the problem of the disruption of EV. Structured, face-to-face interviews were conducted in public places, e.g., city halls or shopping malls, in Lower Saxony, Germany. The research design for each study can be found in Table 3.

No.	Research Question	Epistemology	Paradigm	Data Coll.	Data Analysis	Theoretical Foundation
#1	How can extrinsic motivation influence IT employees' endogenous motivation towards a more innovative intention?	Positivistic	Behaviorally oriented	Cross-sectional survey (n = 354)	Structural equation modeling	Self-determination theory, organismic integration theory, goal-setting theory
2	What is the influence of openness and absorptive capacity on IT entrepreneurship?	Positivistic	Behaviorally oriented	Cross-sectional survey (n = 354)	Structural equation modeling	Open innovation and absorptive capacity
3	How important are social interactions between internal IT employees and the outsourcing partners in the process of internal innovation?	Positivistic	Behaviorally oriented	Cross-sectional survey (n = 354)	Structural equation modeling	Social cognitive theory
4	What is the role of mobile applications concerning the disruptive potential of EVs?	Positivistic	Behaviorally oriented	Structured interview (n = 1461) App analysis (n = 81)	Mixed methods: exploratory interview	

Table 3 - Theoretical Foundation and Research Design

5 Anticipated Contributions

The anticipated contribution of this thesis is likewise directed to practice and research. For practitioners, it should help to explain how entrepreneurial intention and innovative behavior are dependent on influences within the company as well as environemental influences. Concepts like open innovation (Chesbrough, 2003) encourage managers to open up for external impulses and collaborate with external partners, e.g., IT outsourcing partners. With the right concepts, openness in innovation processes allows for the information and knowledge delivered by these partners to be gathered (Faems et al., 2010). This thesis will also help to reveal the role that an employee's motivation plays in this

context; each study provides guidance for managers in IT departments. All insights are statistically and scientifically validated, providing important insights for research. Furthermore, this thesis's goal is to expand the knowledge and understanding in the field of corporate entrepreneurship and IT innovation. A short summary of the contributions is provided below:

Anticipated contribution to theory	**Anticipated contribution to practice**
• Evaluating the influence of endogenous motivation on individual entrepreneurial intention • Providing further evidence that openness and absorptive capacity positively influence the innovation intention of each employee • Providing a model-based evaluation of the influence of social interactions with outsourcing partners on the process of IT innovation • Evaluating the influence of IS on disruptive innovations	• Signaling to IT managers the importance of creating a climate that allows employees to interact innovatively by providing the right job design constraints and corporate environment • Offering insights into the process of knowledge gathering and opening up channels towards the firm´s environment • Providing evidence that strong interaction ties between employees and outsourcing partners lead to a higher innovation intention • Providing insights into the important role of IS in supporting new developments of traditional industries

Table 4 - Summary of the Anticipated Contribution

B Studies on IT Innovation in Non-IT Companies

The following three studies form the core of this thesis. Section B.1 aims to provide answers for RQ1 and helps to create a deeper understanding of the role of endogenous motivation in the innovation process. The second research question (RQ2) will be addressed in B.2, where the goal is to evaluate the concept of organizational learning and openness in the innovation process. Section B.3 explores the role of social interaction outside of the company and provides insights into RQ3, which relates to whether these interactions positively influence the innovation behavior of IT employees beyond the management.

1 Employee's Motivation to Innovate

Title of Article	It's not for the money, it's the motives: The mediating role of endogenous motivations on IT employees´ entrepreneurial behavior
Authors	Henning Krüp, hkruep@uni-goettingen.de* Johann Kranz, jkranz@uni-goettingen.de* Lutz M. Kolbe, lkolbe@uni-goettingen.de* *Georg-August-Universität Göttingen Chair of Information Management Platz der Göttinger Sieben 5 37073 Göttingen
Published	International Conference on Information Systems 2014, Auckland
Abstract	The traditional task of IT departments is currently undergoing a fundamental change from being a functional part of business, to playing a more strategic role in the development of new products (Bharadwaj 2013). The success of this shift is based on the individual employee's willingness to go along with this new approach. But how can we influence employees' individual entrepreneurial motivation and encourage them to develop new features? To answer this question we applied self-determination theory and different process constructs to build a model that explains how the workplace must be designed to encourage employees to work more innovatively. We collected a sample of 354 questionnaires to evaluate our model. The results indicate that job-design constraints in combination with the internal perceived locus of causality (PLOC) provide a starting point for managers to reshape their IT departments. This paper provides the

	necessary insights to overcome this new challenge. *Keywords: Corporate Entrepreneurship, IT innovation, SDT, Goal-setting theory, IT ambidexterity*

Table 5 - Fact sheet of publication no. 1

1.1 Introduction

The role of enterprise information technology (IT) is undergoing a fundamental shift (Westermann et al., 2014). Initially, IT was a functional part of the business, employed to automate and streamline processes and to make information readily available across the organization. Starting in the 2000s, IT's potential as a source of innovation has been recognized (Sambamurthy et al., 2003; Wheeler, 2002). Digital technologies – understood as an assortment of information, computing, communication, and connectivity technologies – are becoming increasingly powerful, small, and efficient. Today, their impacts on customer relationships, internal processes, and value propositions are more substantial than ever before as they affect many traditional industries such as manufacturing, energy, automobile, healthcare, or finance (Capgimini, 2011; Agarwal et al., 2010; Wunderlich et al., 2013). Digital technologies are not just used to transform core processes and enable new services, but beyond that they are embedded in physical goods to make them "smarter" and uniquely identifiable via the Internet (Nambisan et al., 2014; Yoo et al., 2010). In the energy sector, for example, sensor and actuator networks are integrated with a physical grid infrastructure – so-called cyber physical systems – to enable predictive maintenance and improve grid management. Researchers such as Nambisan et al. (2014) state that there is an "unexplored role for IT as an operant resource" in innovation. For new innovations to prosper, it is important to understand these opportunities that originated from new IT technologies and services (See, 2004). The rapid growth of new IT services and the fast development of hardware components require more research in this field of expertise on how to motivate employees to embrace new possibilities and thus place more value on the core business structures.

This digital transformation is forcing firms to create new IT capabilities and add innovative technological features and services around their core products (Bharadwaj, 2013; Rai et al.,

2012; Ray et al., 2005; Sambamurthy et al., 2003). Yoo et al. (2010) argue that the effects of digital innovations will have profound consequences on "a firm's organizing logic and innovation" similar to the impact of modularity on industrial organization (Baldwin and Clark, 2000; Langlois, 2003). The technological discontinuities caused by digital technologies can create opportunities for firms that are capable of transforming their businesses to gain a competitive advantage while threatening those that are not. In order to belong to the group of firms that can combine IT and business knowledge to create process, product, and service innovations, a deep understanding of the opportunities originating from digital technologies is fundamental. Executives observing how fast digital technologies have disrupted some industries are increasingly realizing that the focus of enterprise IT – and consequently IT workers – has to be extended from supporting the day-to-day business towards shaping businesses in the sense of transforming established and developing innovation (Kahn and Sikes, 2014; Guillemette and Paré, 2012). They recognize that, apart from increasing productivity, enterprise IT is becoming increasingly crucial for creating and capturing the core value of business making; it becomes an indispensable part of a successful business strategy (Kohli and Grover, 2008, Watts and Henderson, 2006, Bharadwaj et al., 2013). If companies want to remain competitive in the upcoming years, it is imperative that they not miss this digital transformation of their products. The call for papers in the special issue on "Information Technology and Innovation" of the MISQ (2014) underlines once more the relevance of this topic (Nambisan et al., 2014).

The shifting role of enterprise IT requires more transformational leadership styles that enable and motivate entrepreneurial behavior among IT employees (Leidner et al., 2010; Watts and Henderson, 2006). Furthermore, the working environment must create more favorable conditions that allow for experimenting with new ideas and acquiring new knowledge (Floyd and Lane, 2000). However, as important as it certainly is, a corporate environment that fosters IT entrepreneurship and beneficial job characteristics can only lay the foundation for changing employee attitudes towards generating innovations. Therefore, more importantly, the general attitudes, abilities, and behaviors of non-managerial IT workers must adapt to the new requirements. Recent research on corporate entrepreneurship supports the view that the origin of innovation resides in the "machine rooms" of organizations, more specifically employees at the operational level (Kuratko and Audresch, 2009). The effectiveness of initiating an entrepreneurial orientation in a top-

down fashion often overlooks the possibility that entrepreneurial initiatives emerge autonomously from the bottom (Lumpkin et al., 2009). In this respect, research has found that individuals who perceive their behavior as autonomously driven are more motivated than those perceiving their actions as controlled (Deci and Ryan, 2002). For this reason, we argue that understanding how extrinsic motivations by either explicit or implicit incentives provided by management influence IT employees' endogenous motivations is the key to managing the transition towards a more innovation-centric enterprise IT that motivates IT employees. However, there is a gap in the literature in relation to understanding how top-down–induced extrinsic motivations to foster entrepreneurship influence individual motivations (Wales et al., 2011); our paper addresses this gap. More specifically, we investigate how organizational levers influence employees' endogenous motivations to engage in entrepreneurial activities (e.g., acquisition of knowledge, developing and experimenting with new ideas) and to what extent those activities are mediated by endogenous motivations. Following Deci and Ryan (2000), our study conceptualizes behavior as being primarily driven by the level of individual autonomy that is the extent to which the behavior is in accordance with self-endorsed values, objectives, and needs. Thus, our study goes beyond the dichotomy of extrinsic versus intrinsic motivation, which overlooks the "independent, mutually reinforcing, or countervailing effects of various motivations" (Malhotra et al., 2008).

To address our research question, we developed a comprehensive model drawing from organizational and social psychology research. To test the hypothesized relationships, we collected data from a large-scale online survey. The results will contribute to IS research in three significant ways: First, the study will provide a more fine-grained understanding of which organizational levers are effective in encouraging IT employees' entrepreneurial behavior. Second, it offers insights into the under-researched relationship between IT management and entrepreneurism (Del Giudice and Straub, 2011). Third, the findings will help IT executives and middle managers shift enterprise IT's emphasis towards creating innovations.

The paper is organized as follows: We first present the theoretical foundation and draw our research model. We then outline the research methodology and our results. The paper concludes with a discussion of the key results, implications of our findings, and directions for future research.

1.2 Contextual Background

Today's ever-increasing global competition requires firms to be constantly innovative in order to sustain or gain competitive advantages. Consequently, many firms try to nurture corporate entrepreneurship as it is consistently found to positively influence a firm's innovation performance (Burgelman, 1983; Covin and Sievin, 1991). Corporate entrepreneurship is also an increasingly prominent topic in innovation and management research (e.g., Edelman et al., 2010; Carsrud and Brännback, 2011; Habtay, 2012). While one can find many terms referring to the phenomenon of corporate entrepreneurship (Garret and Neubaum, 2013) and further various definitions (e.g., Burgelman, 1983; Guth and Ginsberg, 1990; Schendel, 1990; Zahra, 1995 and 1997; Chung and Gibbons, 1997), we refer to corporate entrepreneurship (CE) as "an organizational process for transforming individual ideas into collective actions through the management of uncertainties" (Chung and Gibbons, 1997).

The influence of new IT/ICT on entrepreneurship has already been studied by Vu (2004). Based on data from the 1990s, he found that IT development, e.g., the opportunities provided by smaller controllers, created an entrepreneurial culture within firms while also driving productivity gains. This impact has also been confirmed in many different countries by numerous researchers (Armstrong et al., 2002; Jalava and Pohjola, 2001; Kim, 2002; Oulton, 2002; Parham et al., 2001; Van der Wiel, 2001). Based on these former developments and insights, Del Guide and Straub (2011) pursue this line of research even further and ask, "[…] how does IT contribute value to entrepreneurial ventures?". The impact of IT on entrepreneurial ventures (Chesbrough, 2003; Nambisan and Sawhney, 2007; Ma and Wang, 2006) can occur in two different forms. On the one hand, IT offers the possibility of creating an environment that enhances innovation processes. IT not only opens the field for future innovations by involving a global network of partners, customers, and other stakeholders, but also enables deeper customer–client relationships and enhances collaboration on an international level. For the phenomenon of open innovation, for instance, the inclusion of global networks, partners, customers, and other stakeholders into the firm's innovation process is facilitated by IT which support and stimulate inter-firm collaborations (Nambisan et al., 2014). The development of new information technologies, on the other hand, creates entrepreneurial opportunities. This increases the significance of IT with regard to a company's core product and services and thus the relevance of IT for

innovation (Yoo et al., 2010). In this context organizational ambidexterity understood as "an organization's ability to be aligned and efficient in its management of today's business demands while simultaneously being adaptive to changes in the environment" (Raisch and Birkinshaw, 2008) is of special importance (e.g., Im and Rai, 2008; March 1991; Raisch et al., 2009). Traditionally, the focus of IT departments was incrementally refining organizational processes and products (exploitation). IT departments were not expected to be drivers of innovation. Today, IT departments face the challenge pursue both exploitative and explorative (e.g., developing new ideas, experimenting with innovative technologies) activities. This shift is a major change for most IT departments. Whereas exploitative tasks need structure and efficiency, exploration requires creativity and autonomy. Thus, management of IT departments has to adapt its leadership style and to give employees more freedom to experiment and incentives as well to behave entrepreneurially.

Research in the field of entrepreneurship has studied the important role of motivations. Regarding the intrinsic motivation research has focused on aspects such as prestige through exploiting an opportunity (Reynolds et al., 2002) or the drive to create your own business. Entrepreneurs are often highly motivated to create an 'ideal' firm they would like to work for. These influencing factors have been researched thoroughly in the field of management but have thus far been neglected in the field of entrepreneurship (e.g., Quigley and Tymon, 2006). The extrinsic motivation refers to incentives such as money, power and other economic factors, given for entrepreneurial behavior. Entrepreneurs being extrinsically motivated believe their actions lead to rewards (Perwin, 2003; Schumpeter, 1934). The personal profit is often a motivation for these entrepreneurs as they want to achieve wealth and status (Elfving, 2009). Prior research assume that entrepreneurial actions "are motivated by external rewards" (Carsrud and Brännback, 2011). Employees can be motivated by both intrinsic and extrinsic motivation, so it is not an either-or choice. Nevertheless, despite what type of goal an entrepreneur pursues, a key factor to becoming an entrepreneur is motivation (Edelman et al., 2010).

1.3 Hypotheses Development

In the following we develop our research model (see Figure 1.) and derive our hypotheses.

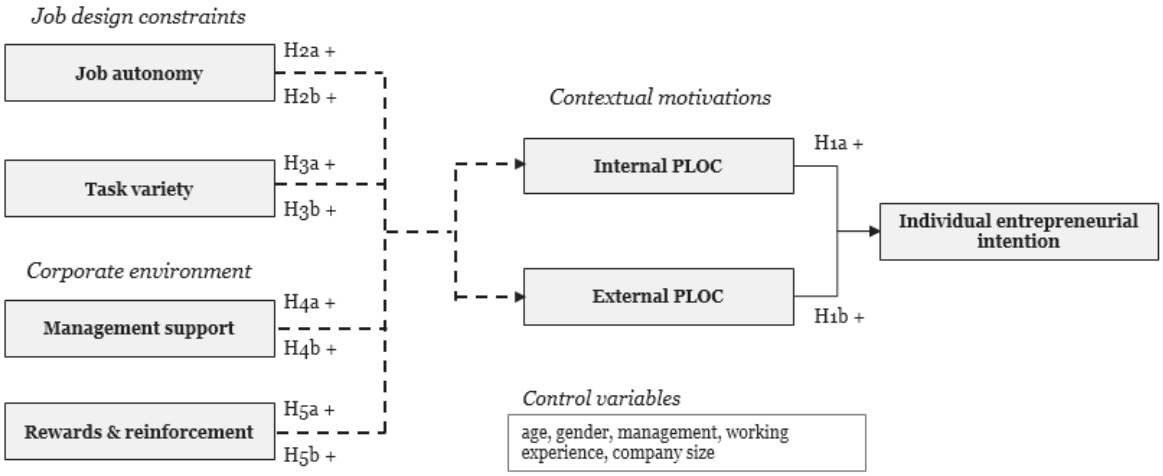

Figure 2 - Research Model

1.3.1 Contextual Motivations

As we study the phenomenon of 'if and how' organizations can improve the innovativeness of IT employees, we think that Self-Determination Theory (SDT) (Deci and Ryan, 1985) is particularly suited. SDT provides a framework to study the impact of social and cultural factors on individuals' sense of volition which eventually determines behavior. According to SDT, an individual's perception of autonomy will increase her/his motivation to behave like an 'in-house entrepreneur' thus enhancing performance, persistence, and creativity. As this study particularly addresses the question if and how IT employee's entrepreneurial behavior can be fostered by organizations, the focus of our study is on different subtypes of extrinsic motivation.

Prior research in IS and CE has treated motivation primarily as exogenous, meaning that human behavior is perceived as triggered by either extrinsic or intrinsic motivation. In contrast, self-determination theory (SDT) claims that motivation is endogenous as individuals initiate all behaviors (Ryan and Deci, 2000; Skinner, 1953). SDT considers behavior as not being motivated by external stimuli but rather by the subjective psychological meanings of these stimuli. This perspective treats behavior as an act of individual volition that may even be undermined by extrinsic rewards, rather than as a result of expected rewards (Curry et al., 1991; Deci, 1971; Dholakia, 2006; Frey and Oberholzer-Gee, 1997; Pritchard et al., 1977).

In predicting individual behavior, the type of motivation – autonomous versus controlled motivation – was found to be more important than the amount of motivation (Deci and Ryan, 2002; Ryan and Deci, 2000; Malhotra et al., 2008; Wunderlich et al., 2013). Individuals who perceive their actions as autonomously driven experience a sense of choice, whereas those whose behaviors are linked to feelings of pressure and coercion originating from external sources perceive themselves as being controlled. We expect that working conditions that support individuals' feeling of autonomy regarding entrepreneurship foster their creativity, engagement for activities and enhance their performance in the area of innovation.

In understanding the influence of the perceived degree of self-determination on behavior, the Organismic Integration Theory (OIT), a sub-theory of SDT, has proved to be valuable in a number of scientific areas (Cadwallader et al., 2010; Deci and Ryan, 2002). OIT conceptualizes individually experienced levels of autonomy as existing along a continuum of motivation (see Figure 2), referred to as the perceived locus of causality (PLOC), which is the degree to which an individual experiences behavior as initiated and endorsed by the self (Ryan and Connell, 1989). The degree to which individuals appropriate and internalize external influences determines the perceived locus of causality, ranging from external to internal regulation. Regulation refers to an internalized principle or value (e.g., an individual sense of autonomy) that controls behavior (Cadwallader et al., 2010; Wunderlich et al., 2013). The more a value is appropriated and internalized, the more the regulation is perceived as autonomous. Hence, external regulation describes controlled forms of behavior that are performed because of external influences or pressures. In contrast, internal regulation implies that people perceive themselves as the origin of their behavior. That is, they experience the behavior as more self-determined, reflecting a higher degree of internalization. Thus, the continuum ranges from two relatively autonomous forms of motivation (i.e., intrinsic and identified regulation) to two relatively controlled forms of motivation (i.e., external and introjected regulation) (Ryan and Connell, 1989).

Internal PLOC

Internal PLOC refers to a high degree of internalization of extrinsic motivations such as goals or incentives. This means that external regulations have become personally meaningful to individuals and perceive their behavior as autonomously motivated (Ryan and Connell, 1989). Sheldon (2002) also stated that under the influence of internal PLOC

individuals feel congruent with their psychological needs. For our research, we assume that when individuals perceive their entrepreneurial behavior as autonomously driven, their intention to try new things, gather and combine new knowledge will increase. Prior research suggests that individuals who are autonomously motivated in congruence with personal goals and values are more motivated to overcome obstacles (Csikszentmihalyi, 1990). Therefore, we assume that the intention to invest time and effort in unsecure and demanding innovation projects, is higher if people have fully internalized extrinsic motivations (Agarwal and Karahanna, 2000; Deci, 1975). Therefore, we propose:

H1a: Internal PLOC positively influences individual entrepreneurial intention.

External PLOC

Individuals performing behavior under the influence of external PLOC is perceive their behavior as externally coerced. Thus, external PLOC is the least autonomous form of extrinsic motivation. Individuals then perceive their behavior as a result of external authorities or compliance (Ryan and Connell, 1989). However, although individuals perceive behavior as driven by extrinsic motivations such as financial rewards or social appreciation, these motivations may ultimately lead to individuals engaging in entrepreneurial activities. Thus, employees may still try to be more innovative because of external stimuli which are important to them. Therefore, we propose:

H1b: External PLOC positively influences individual entrepreneurial intention.

1.3.2 Job Constraints

According to goal-setting theory tasks must be both realistic and complex to increase the goal achievement of employees (Locke and Latham, 2002, 2006). Tasks must also provide the five main principles of clarity, challenge, commitment, feedback, and task complexity. Loock et al. (2013) additionally proposes to ‘free choice of time’ which we assume to be of particular importance for employees having time to gather new external knowledge and experiment with new ideas. Therefore, we include job variety as a construct in our model. As our research focuses on innovations, we did not consider the principal of clarity, as exploring is an inherently unstructured process. To reflect the principles of challenge and complexity, we incorporate task variety as a construct in our research model as it measures the degree to which employees are confronted with new and varied tasks on a regular basis.

Innovative companies such as Google or 3M have demonstrated that if a job offers high task variety, the employees gather experiences in different domains which increases their ability to solve complex problems. Combined with the freedoms provided by job autonomy, employees are able to engage in innovative activities. Hornsby et al. (1993, 2002) concretize the relationship between job autonomy and individual entrepreneurial intention and argue that job autonomy is one of the core constructs for creating a suitable climate for corporate entrepreneurship. Prior research has shown that job autonomy positively affects firm-level CE and the number of ideas actually implemented by managers (Hornsby et al., 2009, Ling et al., 2008). We expect that job autonomy, as part of job enrichment (Hackman and Oldham, 1980), enhances employees' motivation to undertake innovative activities. Google, as one of the currently leading companies in innovation, began the "20% time" program in 2004, allowing employees to take one day a week to work on their own projects. This resulted in successful innovations such as Google AdWords. As these innovative activities involve trial and error, autonomy and freedom are essential to be innovative even in the face of failure (Ramamoorthy et al., 2005). Generating innovations requires to increase employees' job autonomy by reducing regulations, bureaucracy, and rules as far as possible (Herriott et al., 1997). Therefore, we expect job autonomy to be positively related to the extent to which an employee is motivated by internal. We also assume that the effect of job autonomy is at least partially mediated by internal PLOC. Therefore, we propose:

H2a: Job autonomy positively influences the internal PLOC.

H2b: Job autonomy negatively influences the external PLOC.

H2c. Internal PLOC at least partially mediates the positive effects of job autonomy on the individual entrepreneurial intention.

H2d: External PLOC at least partially mediates the positive effects of job autonomy on the individual entrepreneurial intention.

Kanter (1988) argues that employees can feel "crippled" when there is little task variety, a feeling that is associated with little challenge and meaning of the job to employees. This has also been confirmed by other researchers, who state that a routine job decreases the motivation of employees (Mueller et al., 1994). Conversely, this means that variety in carrying out a job is positively related to an employee's endogenous motivation regarding

CE. Different tasks as part of the job are helpful in providing a more enjoyable and interesting job. Further, employees gather experiences and knowledge in diverse domains, which is regarded as an important antecedent of innovation to emerge. Within groups, a climate more conducive to innovation is established if the group faces more complex tasks and greater task variety (Antoni, 2005). On the individual level we also expect that greater task variety will lead to employees be more motivated through internalized goals (internal PLOC) Therefore, we state:

H3a: Task variety positively influences the internal PLOC.

H3b: Task variety positively influences the external PLOC.

H3c: Internal PLOC at least partially mediates the positive effects of Task variety on the individual entrepreneurial intention.

H3d: External PLOC at least partially mediates the positive effects of Task variety on the individual entrepreneurial intention.

1.3.3 Corporate Environment

Goal-setting theory contends that feedback and commitment are important elements with regard to motivation. We include those two principles by incorporating management support and rewards and reinforcements in our model.

The motivation of employees to innovate and individual entrepreneurial intention are linked to management support (e.g., Stevenson and Gumpert, 1985; Katz and Gartner, 1988). A lack of management support leads to a higher risk awareness of employees. This inhibits employees from being innovative and reduces motivation because employees fear "being victimized if the innovation attempt fail[s]" (Manimala et al., 2005). On the other hand, if management supports innovation and tolerates failures, this generates an environment in which entrepreneurial thinking and action of employees is encouraged. Although innovative activities are associated with a high risk of failure, employees have to be assured that they are granted with adequate resources by management (Katz and Gartner, 1988).

Prior research has focused on top-level management support. Top management support is defined as "as the corporate parent's senior-level executives' support of and commitment to the ICV's [internal corporate venture] success" (Gerret et al., 2013). Management

support not only comprises supporting employees with organizational and financial resources, but moreover that senior managers champion these new ventures (Greene et al., 1999). As we study entrepreneurism on the individual level, we believe that middle managers in direct contact with IT workers play a crucial role for enhancing or decreasing employees' motivations to be innovative. Since, most senior managers are locked in their conventional business with fix-defined products, middle managers and their teams are found to be the origin for discovering and implementing innovations (Kuratko and Audretsch, 2009; Yu and Hang, 2010). Thus, we propose that middle manager's support of corporate entrepreneurship has a positive influence on employee's internal and external PLOC. Therefore, we state:

H4a: Management support positively influences the internal PLOC.

H4b: Management support positively influences the external PLOC.

H4c: Internal PLOC at least partially mediates the positive effects of management support on individual entrepreneurial intention.

H4d: External PLOC at least partially mediates the positive effects of management support on individual entrepreneurial intention.

Apart from management support, research suggests that rewards and reinforcements are major extrinsic motivations. Rewards are often granted for outstanding work performance, e.g., new product innovations. These could be higher salaries, job security, or any other kind of promotions and are found to motivate employees (Brickley et al., 2000). However, extrinsic rewards can have a negative impact on an employee's intrinsic motivation. Intrinsically motivated individuals can find themselves feeling controlled by these rewards. Prior research called this phenomenon motivation crowding out (Frey and Oberholzener-Gee, 1997; Frey and Jegen, 2001). It causes a shift in the perceived locus of causality from internal to external (Deci and Ryan, 2000; Lepper et al., 1973). We assume that, as a result, the intrinsic motivation of an employee decreases, thereby reducing creativity and performance. In contrast, if managers provide autonomy as well as support and recognition, the performance of intrinsically motivated employees will improve (de Charms, 1968). Thus, if balanced appropriately, rewards and reinforcements should to be positively associated to internal PLOC to a moderate extent and to a higher extent to external PLOC. Therefore, we propose:

H5a: Rewards and reinforcements positively influence the internal PLOC.

H5b: Rewards and reinforcements positively influence the external PLOC.

H5c: Internal PLOC at least partially mediates the positive effects of rewards and reinforcements on individual entrepreneurial intention.

H5d: External PLOC at least partially mediates the positive effects of rewards and reinforcements on individual entrepreneurial intention.

1.4 Research Design and Method

1.4.1 Data-Collection Procedure and Sample

To test our research model, we collected data from an online survey conducted in February 2014. We collaborated with a market research company hosting a panel of employees currently working in an IT department of non-IT firms in Germany and the UK. Our survey was developed in English and translated into German by an independent translator, then translated back by another translator to establish conceptual consistency. Of the initial sample of 526 participants that took part in the study, 71% completed the survey (n = 372). From those, 18 with an implausibly short handling time were removed. The sample's demographics are provided inTable 6.

Total Sample	*n* = 354	Percentage
Gender		
Male	245	69%
Female	109	31%
Age		
19–25	43	12,1%
26–35	153	43,2%
36–45	88	24,9%
46–55	50	14,1%
56–65	19	5,4%
66 and over	1	0,3%
Management		
Yes	310	88%
No	44	12%

Total Sample	*n* = 354	Percentage
Working Experience		
< 2 years	20	6%
3–5 years	53	15%
6–10 years	94	27%
11–15 years	63	18%
16–20 years	46	13%
> 20 years	78	22%
Company size		
< 50	42	12%
50–99	39	11%
100–499	86	24%
500–999	75	21%
1.000–2.499	46	13%
2.500–9.999	33	9%
>10.000	33	9%

Table 6 - Demographics of Participants

1.4.2 Measurement of Constructs

We followed standard psychometric scale development procedures. All items were assessed on a seven-point Likert-type rating scale with the anchors "strongly disagree" (1) and "strongly agree" (7). We used validated scales when possible and adapted some for the context of our study. In a first step, the items were evaluated by scholars in the areas of corporate entrepreneurship and motivation research and IT practitioners. Based on their assessments, some items were reworded to achieve face and content validity of the scales (Hardesty and Bearden, 2004; Moore and Benbasat, 1991). In addition, we conducted two pilot studies (n = 23) to evaluate and refine our reflective measures. The reliabilities of the scales for the second pilot study indicated that they were appropriate for use in a larger study (Brown and Venkatesh, 2005). The final items of the latent variables and the psychometric properties are presented in Table 7

Construct (Source)	Items	Factor Loading
Job autonomy (Morris and Venkatesh, 2010)	My work gives me a chance to use my personal initiative or judgment in carrying out the work.	.892***
	My work allows me to make a lot of decisions on my own.	.923***
	My work provides me with significant autonomy in making decisions.	.916***
Task variety (Morris and Venkatesh, 2010)	My work involves a great deal of task variety.	.897***
	My work concerns a wide array of responsibilities.	.911***
	My work involves doing a number of different things.	.895***
Management support (Hornsby et al., 2013)	People are often encouraged to take calculated risks with ideas around here.	.856***
	This business unit supports many small and experimental projects, realizing that some will undoubtedly fail.	.850***
	Senior managers encourage innovators to bend rules and rigid procedures in order to keep promising ideas on track.	.822***
	Those employees who come up with innovative ideas on their own often receive management encouragement for their activities.	.844***
	Money is often available to get new ideas off the ground.	.830***
Rewards/ reinforcement (Hornsby et al., 2013)	My supervisor will give me special recognition if my work performance is especially good.	.945***
	My manager will tell his/her boss if my work was outstanding.	.934***
External PLOC (Ryan and Connell, 1989)	I contribute to the development and implementation of innovative ideas because it is financially attractive to me.	.785***
	I contribute to the development and implementation of innovative ideas because others think I should do that.	.839***
	I contribute to the development and implementation of innovative ideas so that colleagues or supervisors don't have to motivate me to do so.	.786***
	I contribute to the development and implementation of innovative ideas because it is respected within the firm.	.809***
	I contribute to the development and implementation of innovative ideas because I don't want others to get mad at or disappointed with me.	.684***
Internal PLOC (Ryan and Connell, 1989)	I contribute to the development and implementation of innovative ideas because I want to deepen my understanding of the respective subject.	.870***
	I contribute to the development and implementation of innovative ideas because I want to learn new things.	.854***

	I contribute to the development and implementation of innovative ideas because I want to find out If I'm right or wrong.	.842***
	I contribute to the development and implementation of innovative ideas because it is personally important to me to deal with new ideas.	.881***
	I contribute to the development and implementation of innovative ideas because I don't want to oppose to the development and implementation of new ideas.	.688***
Individual entrepreneurial intention (de Jong, 2011)	If I identify a new business opportunity, I would promote and champion my idea to co-workers and superiors.	.805***
	If I had an idea for innovations, I would try to assess its long-term opportunities and threats for the company.	.839***
	I have always wanted to implement innovations by myself.	.788***
	If I had the opportunity, I would like to develop a product or service on my own (or in a team).	.669***
	I intend to develop innovative ideas in the company's core business and implement them within the company in the future.	.788***
	I think that in the future I will develop innovative ideas in the company's core business and implement them within the company more often.	.823***
Note: * p < .05; ** p < .01; *** p < .001; † removed items.		

Table 7 - Model and Constructs

1.5 Analysis and Results

The research model was validated using structural equation modeling. We applied the component-based partial least square (PLS) approach using SmartPLS version 2.0.M3 (Ringle et al., 2005). Following the two-stage procedure proposed by Anderson and Gerbing (1988), we first assessed the psychometric properties of the measurement model and subsequently tested the hypotheses with the structural model.

1.5.1 Assessment of Measurement Model

To assess the reflective variables, we conducted reliability and validity tests according to the guidelines of Gefen and Straub (2005). As illustrated in Table 2, all but three reflective items loaded significantly on the underlying constructs with values well above the recommended threshold of .707 (Chin, 1998) and none of the items loaded on their construct below the cutoff value of .50. Composite reliability (CR) scores also exceeded

the recommended threshold of .70 (Gefen and Straub, 2005) (see Table 3). Furthermore, we conducted a confirmatory factor analysis to check cross-loadings. All indicator items loaded significantly more on their corresponding construct than on any other construct. Hence, the tests imply that indicator and construct reliability were satisfactory. Convergent validity was assessed by examining the constructs' average variance extracted (AVE). The results indicate that the AVE of each construct was well above the common threshold of .50 (Bhattacherjee and Premkumar, 2004). To establish discriminant validity, the criterion of Fornell and Larcker (1981) was applied. As the squared correlations between any two constructs are lower than the corresponding AVE, discriminant validity was also established.

Construct	Range	Mean (STD)	CR	AVE	CA	IEI	EPLOC	IPLOC	JA	TV	MS	RR
IEI	1–7	5.32 (0.95)	.91	.62	.88	**.79**						
EPLOC	1–7	4.81(1.04)	.89	.61	.85	.56	**.78**					
IPLOC	1–7	5.49 (0.84)	.92	.69	.89	.76	.56	**.83**				
JA	1–7	5.48 (0.93)	.94	.83	.90	.66	.52	.70	**.91**			
TV	1–7	5.44 (0.91)	.93	.81	.88	.62	.47	.69	.78	**.90**		
MS	1–7	4.93 (0.97)	.92	.71	.90	.56	.62	.50	.59	.51	**.84**	
RR	1–7	5.31 (1.03)	.94	.88	.87	.49	.44	.50	.57	.50	.64	**.94**

Note: STD: standard deviation; CR: composite reliability; AVE: average variance extracted; CA: Cronbach Alpha; IEI = individual entrepreneurial intention; EPLOC = external PLOC; IPLOC = internal PLOC; JA = job autonomy; TV = task variety; MS = management support; RR = rewards and reinforcements; bold diagonal elements represent the square-root of AVE.

Table 8 - Construct Correlations

1.5.2 Testing the Structural Model

The research model was validated using structural equation modeling. The significance of the parameter estimates was calculated applying bootstrapping with 3.000 samples. Figure 2 shows that the hypothesized direct effects of the endogenous motivations were supported (H1a, H1b). The results also confirmed the positive effects of job design constraints on employee motivation. We could not confirm the positive effects of management support and rewards and reinforcements on motivation towards the individual entrepreneurial intention. Only management was statistically significant as an influencing factor.

Based on the model estimations, our hypotheses H1a (β = .65, p > .001) and H1b (β = .189, p > .001) were confirmed. Therefore, we can state that both the internal and the external PLOC positively influence the individual entrepreneurial intention of IT department employees.

For the effect of the job design constraints on the employees' PLOCS we can state that the job autonomy has a significant positive effect on the internal PLOC but no significant effect could be shown on the external PLOC. Hence, we find support for H2a (β= .336, p > .001) but not for H2b (β= .152, n.s.).

Task variety as the second job design constraint performs in a similar way as the autonomy. We found a significant positive effect on the internal PLOC while no effect could be found for the external PLOC. Thus we find support for H3a (β= .357, p > .001) and similar to the job autonomy no support for H3b (β= .011, n.s.).

For the corporate environment we used two constructs that are suitable for our study. In contrast to job design constraints, management support, as part of the corporate environment, has a significant, positive effect on the external PLOC and no effect on the internal PLOC. As a result, H4b (β = .490, p > .001) is supported, while H4a (β = .053, n.s.) finds no support by our measurement.

The statistically significant influence of rewards and reinforcements as a construct of the corporate environment on the contextual motivations was not supported by our data. Therefore, we state that H5a (β = .096, p > n.s.) and H5b (β = -.016, n.s.) are not supported. Figure 2 illustrates the model and the results of the hypotheses testing.

We also tested for common method bias because the independent and dependent variables were provided by the same respondent. Both the Harman's single-factor test (Podsakoff et al., 2003) and the marker variable test (Lindell and Whitney, 2001) indicate that common method bias was not a threat to the validity of our study.

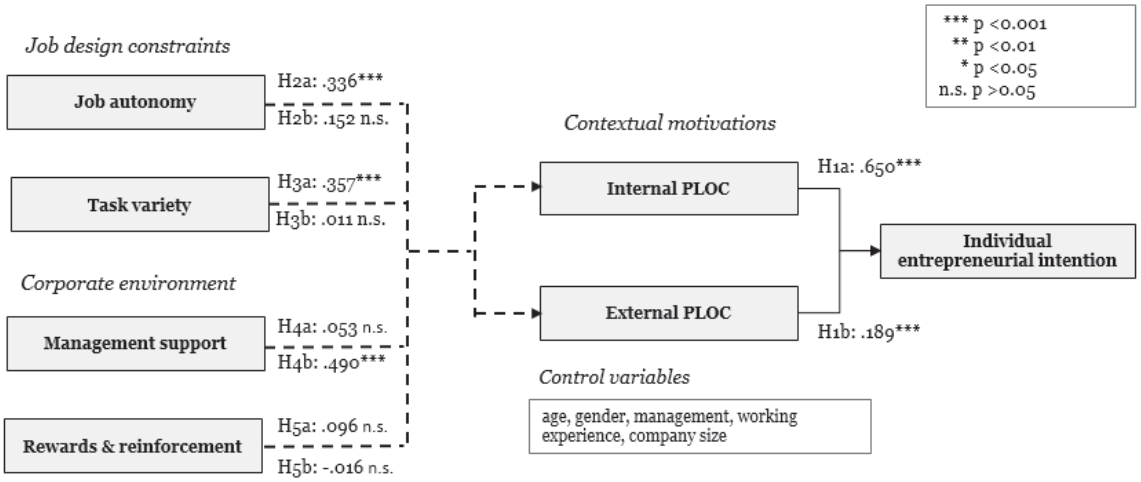

Figure 3 - Results

1.5.3 Mediation Analyses

For testing our hypothesized mediating role of the external and internal PLOC, we followed the procedures of Baron and Kenny (1986). The following conditions must be fulfilled to verify the mediating effect. First, without checking with the mediator, the independent variable (IV) must account for variations in the depended variable (path c). Second, there must be a significant variation in the mediator to the dependent variable (path b). Third, there must be a significant variation in the IV to the mediator (path b). If these conditions are fulfilled and the effects of the IV on the dependent variable decrease while checking for the mediation (path c') compared to path c, we can state that there is a mediating effect. To determine whether this is a full or partial mediation, we must check whether path c' is significant. If path c' is still significant, it is a partial mediation; if path c' is statistically insignificant, it is a full mediation. (Baron and Kenny, 1986).

The significance of the mediation can be examined with the Sobel test (Sobel, 1982). This test of indirect effects checks whether the IV's effect decreases after inserting the mediator into the model. Our results are presented in Table 4. We can state that both the internal and the external PLOCs partially mediate the job design constraints and the corporate environment.

Hypotheses	IV	MV	Model II			Model I	Sobel's Test	Mediation
			a	b	c'	c	z	
M1	JA	EPLOC	.531***	.305***	.497***	.661***	6.002***	Partial
M2	JA	IPLOC	.701***	.582***	.251***	.661***	8.292***	Partial
M3	TV	EPLOC	.487***	.354***	.448***	.628***	6.430***	Partial
M4	TV	IPLOC	.694***	.630***	.183*	.628***	10.110***	Partial
M5	MS	EPLOC	.625***	.330***	.370***	.578***	4.303***	Partial
M6	MS	IPLOC	.499***	.631***	.250***	.578***	6.869***	Partial
M7	RR	EPLOC	.454***	.440***	.299***	.503***	6.090***	Partial
M8	RR	IPLOC	.500***	.677***	.162***	.503***	7.257***	Partial

Note: IV = independent variable; Model I: without controlling for the mediator (EI); Model II: with controlling for the mediator; Path a: IV -> mediator; Path b: mediator -> intention; Paths c and c': IV-> intention; * p < .05; ** p < .01; *** p < .001.

Table 9 - Mediation Analyses of Entrepreneurial Intention

1.6 Discussion and Implications

Our study focuses on an important gap regarding the role of endogenous motivation on employees' individual entrepreneurial intention. To prepare IT managers for the future challenge of an IT department that is increasingly concerned with innovative and explorative tasks, it is important to understand the factors that influence individual entrepreneurial intention. In our study we created a model analyzing the roles of endogenous motivation, job design constraints, and corporate environment and tested them empirically. Our findings should help managers to understand the direct influence of job design constraints and the corporate environment on employees' endogenous motivation regarding individual entrepreneurial intention.

Our proposed model was tested with 354 employees of IT departments in non-IT firms. We found that endogenous motivation have a major influence on employees' individual entrepreneurial intention. The results indicate that when extrinsic motivations are fully internalized (internal PLOC) the more motivated employees are to engage in innovative activities. Task variety and job autonomy are key drivers of increasing employees' motivation regarding entrepreneurship. Our findings show that these job design constraints have the greatest influence on the internal PLOC. Management support and rewards and reinforcements however, were not found to have a significant impact on internal PLOC.

External PLOC is also positively related to entrepreneurial innovation. Although weaker than the effect of internal PLOC, results imply that external PLOC still has a positive effect on individual entrepreneurial intention. We could not find evidence for the impact of job design constraints on the external PLOC. Management support, however, significantly influences the external PLOC. Surprisingly, we could not find any effect of rewards and reinforcements impacting external PLOC.

The results of the mediation analyses (see Table 4) show the important and statistically significant role of endogenous motivations. Both the external and internal PLOCs partially mediate the influence of the corporate environment, management support and rewards and reinforcements, on individual entrepreneurial intention. The internal PLOC also partially mediates the influence of job design constraints, job autonomy and job variety.

The results also have implications for practitioners. In this study we found that if being innovative becomes personally meaningful to employees, they will have a higher individual entrepreneurial intention. IT managers who are concerned with the ambidextrous role of IT and exploration tasks, can build upon our work. Therefore, managers need to provide organizational and financial resources as well as championing the new ventures. To reduce workplace monotony and low task complexity, which is negative related to entrepreneurial actions, managers should offer a high degree of task variety and by that more complex task. To handle these complex tasks and also to work innovative, employees need a high degree of autonomy. The success of Google in innovation shows that giving employees free space and time for innovation motivates employees to develop innovations. This study indicates that firms which aim at increasing corporate entrepreneurship in IT departments should reduce the time and effort IT employees spend on routine, exploitative tasks and increase employees' exposure to other domains and more exploratory tasks. We demonstrated that autonomous motivation is particularly important for employees intending to behave as in-house entrepreneurs, while less autonomous extrinsic motivations have a weaker effect. Therefore, middle managers should carefully adjust job designs and incentives systems to satisfy the specific need of their employees. Our study shows that the entrepreneurial intention is promoted by employees rather than imposed top-down. If job constraints, job autonomy and task variety, as well as the corporate environment, management support and rewards and

reinforcements, are adjusted right, managers can stimulate the entrepreneurial intention of employees but are not able to impose it.

Besides these contributions, some limitations should be considered when interpreting the results. The study was conducted in Western European countries which potentially limits the generalizability of this study with respect to other cultures. Therefore, future research should validate our findings in different cultures. Further research should also focus on extending our model by finding moderating effects on both the PLOCs and individual entrepreneurial intention. Furthermore, we encourage future research to focus on how to transform the individual entrepreneurial intention into corporate entrepreneurial action.

1.7 Conclusion

Thus far, entrepreneurial behavior research has not played a significant role in IS research. As the role of IT as a trigger and enabler of innovation is increasing, more research on that topic is needed. Our study provides important insights into the role of endogenous motivation and its mediating effects on the job design constraints and corporate environment relationships included in our research model. As we focused on the special case of IT departments, our results provide new knowledge on how middle managers can create an innovative work environment. The study provides a starting point for research on how to enable digital transformations of businesses.

2 Organizational Learning

Title of Article	Feed the machine – an empirical investigation of the impact of openness in innovation on IT entrepreneurship
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Abstract	In the future, if businesses want to innovate, IT will have to play a substantial role. Furthermore, innovating with IT will most likely imply opening up the innovation channel and collaborating with various kinds of external partners, as digital platforms and eco-systems involving various actors arise. According to prior research, emphasizing external innovation collaboration bears the risk of inhibiting internal innovation. As the ability to innovate with IT becomes a key differential factor in almost every industry, business managers – especially in non-IT firms – must cultivate the entrepreneurial role of their IT departments and the respective employees. Therefore, the question arises of how the focus on external innovation sources and the emphasis on internal innovativeness of IT professionals relate to each other. Prior research has generated conflicting results on this issue. With our large-scale (n = 354) empirical analysis, we provide evidence that firm openness fosters the entrepreneurial behavior of IT professionals. Furthermore, this impact is mediated by the absorptive capacity of the IT unit.

	Consequently, as our model shows, valuable external knowledge can be integrated for internal innovation purposes, thus driving both IT professionals' willingness to act entrepreneurially as well as their perceived ability to do so. *Keywords: Open Innovation, Absorptive Capacity, Corporate Entrepreneurship, Innovation Management.*

Table 10 - Fact sheet of publication no. 2

2.1 Introduction

Due to the increasing pervasiveness of information technology (IT) in everyday life (Yoo, 2010), more and more industries must take IT into account when considering innovation. As Nambisan (2013) points out, "Digital technologies are being embedded into an ever-increasing range of products and services – from cars and toys to household appliances and medical devices – thereby expanding the role and relevance of IT in any innovation" (Nambisan, 2013, p. 216). Stemming from this elaborated role, IT departments today face completely different expectations than they did a decade ago. For corporate IT, it is no longer sufficient to simply increase the efficiency of existing business processes by, e.g., automating manual work practices (Melville et al., 2004). Moreover, it is insufficient for IT to merely be aligned with business strategy (Henderson and Venkatraman, 1993); instead, corporate IT must now contribute to a firm's innovation processes.

However, this new and important role is far from easy to fulfill for most IT departments, especially in non-IT industries. IT departments have a history of being a support function whose goals are, in the best case, derived from the business strategy (Guillemette and Paré, 2012). Now, in many industries the tables have turned as firms have begun implementing digital business strategies (Bharadwaj et al., 2013). This demands a changed set of skills, competences, and resources for the IT function. Thus, in the digital age the role of IT in innovation has changed from being a simple operand resource, i.e., an innovation enabler, to being an operant resource that triggers innovation processes and outcomes that rely on digital platforms and multiple players in the innovation ecosystems (Nambisan, 2013). One way of coping with these challenges would be to support the entrepreneurship of IT

professionals (Watts and Henderson, 2006). Innovative business ideas from IT employees that are implemented within the firm are a desirable outcome in a world where IT increasingly penetrates business or even becomes the business.

However, not only has the importance of innovations in IT changed but the logic of innovation processes is also shifting (Yoo et al., 2012). Although IT departments have historically been responsible for managing and executing the potential of IT for the business, in the digital age they are increasingly challenged to keep pace with IT developments stemming from fields of knowledge distant from their area of expertise. As the phenomenon of consumerization demonstrates, corporate IT is in danger of being bypassed if it does not meet the increased expectations of managers, employees, or customers, which result from private consumer IT usage (Gregory et al., 2014). IT units are surrounded by pervasive IT that originate from areas distant from their core knowledge base but invade the business environment. In the digital age, ecosystems emerge that involve increases in both collaboration and competition (Henningsson and Hedman, 2014; El Sawy and Pereira, 2013; Yoo et al., 2010). To create innovations in such an interconnected environment, IT departments must open up their innovation channels by getting in touch with technology partners, customers, competitors, etc. (Yoo et al., 2012). Nevertheless, openness in IT innovation does not guarantee that opportunities will be recognized and realized by corporate IT. They must be able to effectively acquire, interpret, and exploit the external knowledge – a capability referred to as absorptive capacity.

Prior research has "largely ignored the connections between internal and external innovation" (Faems et al., 2010). However, it has also indicated possible tensions resulting from external innovation collaboration as it might hinder the ability to identify and develop innovations internally (Xu et al., 2013). While the importance of absorptive capacity for, e.g., firm performance, has been proven in general several times, there is still a lack of understanding concerning its effects on internal innovativeness (West and Bogers, 2014) – particularly the relationship between internal innovations and collaboration with the external environment. Research has produced conflicting results on these issues, finding both substitutionary and complementary effects of absorptive capacity on internal innovativeness (West and Bogers, 2014). One could argue that absorptive capacity drives external innovation sourcing, thus reducing resources available for internal innovations. On

the other hand, however, the enhanced knowledge transfer from external sources to the company, driven by absorptive capacity, might generate ideas for internal innovations.

Thus, a dilemma arises from the need to open up and collaborate in IT innovation while avoiding the danger of inhibiting internal innovativeness. Though this predicament may have long existed, it becomes crucial when IT gains in importance and IT innovations are basically business innovations. As IT competence becomes a key differentiator in competition, strategic disadvantages emerge if the needed competence lies outside the firm boundaries. In this paper, we therefore aim to provide insights into the following research question: *What is the influence of openness and absorptive capacity on IT entrepreneurship?*

In answering this question, we attempt to shed light on the black box of how the increased openness of the firm in innovation initiatives and the IT department's ability to absorb external knowledge influences the individual entrepreneurial behavior of IT professionals. In order to do so, we built a comprehensive model that attempts to bridge the gaps among the organizational, IT-unit, and individual layer and conducted a large-scale (n = 354) empirical investigation to examine the specific relationships.

The remainder of the paper is organized as follows. First, we lay out our theoretical foundation by drawing from prior research on new challenges for the IT function as well as the concepts of absorptive capacity, open innovation, and IT entrepreneurship. Afterwards, we develop our hypothesis and explain the methodological approach taken. Finally, we present and discuss our results and derive important implications for business practice and future research.

2.2 Theoretical Background

2.2.1 Challenges for corporate IT in the digital age and IT entrepreneurship

As described by Bharadwaj et al. (2013), the role of the IT function is currently undergoing a fundamental change. While IT has historically been considered a business function, or an internal service provider (Queiroz and Coltman, 2014) intended to support given business objectives (Guillemette and Paré, 2012), its role has been increasing in importance. Instead of aligning IT to business strategy, digital business strategy, i.e., an "organizational strategy formulated and executed by leveraging digital resources to create differential value" (Bharadwaj et al., 2013), is on the rise. El-Sawy and Pereira (2013) describe the

changing role of IT from being a business tool – an enabler of business processes – to a state in which it is inseparably connected with the business itself. As Bucherer et al. (2012) report from a recent case study, "Employees from the IT department suddenly had to deal with customers instead of focusing on internal process optimization" (Bucherer et al., 2012).

Consequently, although innovation has always been an important task for IT departments (Merali et al., 2012), it will become even more important in the digital age as IT innovations are business (service/product and business model) innovations. However, while corporate IT functions in the past were used to drive innovations more or less on their own, innovation ecosystems broaden in the digital space (Bharadwaj et al., 2013). With the diffusion of digital platforms, interorganizational collaboration on shared architectures increases (El-Sawy and Pereira, 2013). Yoo et al. (2012) describe future IT innovations as distributed in nature and point out that "[n]ot only are innovations increasingly moving toward the periphery of an organization, but the distributed innovation spurred by pervasive digital technology increases the heterogeneity of knowledge resources needed in order to innovate" (Yoo et al., 2012). However, the emerging ecosystems are not free from tensions, as collaboration partners often are competitors at the same time (Henningsson and Hedman, 2014).

The increasing penetration of digital technologies into everyday life (Yoo, 2010) brings along another challenge that has been discussed under the theme of consumerization (Gregory et al., 2014). Initial research on this emerging topic has explicitly described the tensions for IT functions resulting from employees bringing consumer technologies and their related expectations to the workplace (Ruch and Gregory, 2014). The consumerization of IT turns the direction of innovation upside down as new technologies emerge from the private space (Niehaves et al., 2012). Hence, corporate IT faces competition from very different areas and is in danger of being left behind if it cannot manage to meet the transferred expectations (Gregory et al., 2014). Business managers might then bypass their own IT function and instead collaborate with external partners (Niehaves et al., 2012). This reliance on external partners is particularly dangerous when IT becomes a key aspect in business innovation.

In sum, these developments lead to a specific profile for corporate IT when it comes to innovation. IT must be able to open up and collaborate with external partners while also

having the ability to acquire and integrate knowledge from dispersed areas, apply it to its own contexts, and contribute to business innovations in order to avoid being bypassed by outside players. In order to address these challenges, corporate entrepreneurship, i.e., "an organizational process for transforming individual ideas into collective actions through the management of uncertainties" (Chung and Gibbons 1997), carried out by the IT function is a promising avenue, as it has been reported to enhance innovation performance in its respective contexts (e.g., Burgelman, 1983; Covin and Slevin, 1991). As the definition of corporate entrepreneurship above already indicated, recent research on the topic has identified the specific importance of the individuals operating in the "machine rooms" for the initiation of entrepreneurial actions (Kuratko and Audresch, 2009). When focusing on IT innovations, this machine room is the IT department with the respective IT professionals working within.

Much research has found a positive influence of IT on entrepreneurship (e.g., Armstrong et al., 2002; Jalava and Pohjola, 2001; Kim, 2002; Oulton, 2002; Parham et al., 2001; Van der Wiel, 2001; Vu, 2004). Furthermore, the driving and inhibiting organizational factors (e.g., Leidner et al., 2010; Watts and Henderson, 2006; Floyd and Lane, 2000) as well as the influence of intrinsic and extrinsic motivations on entrepreneurial behavior (e.g., Kruep et al., 2014; Carsrud and Brännback, 2011; Edelman et al., 2010) have been investigated. However, to the best of our knowledge, what is missing to date is empirical evidence on the impact of firm openness and external innovation collaboration on the internal innovativeness of IT departments and individual entrepreneurship of IT employees. Employing this perspective is important because "employee innovation behavior has been predicted by factors at the organizational, the job, and the individual levels, but research reflecting these three perspectives has not been examined for relative and interactive effects" (Kinnamon and Fabian, 2010, p.3).

2.2.2 Open innovation and absorptive capacity

Since its introduction by Chesbrough (2003), the concept of open innovation has initiated substantial related research (Dahlander and Gann, 2010). According to Lichtenthaler (2011), "Open innovation is defined as systematically performing knowledge exploration, retention, and exploitation inside and outside an organization's boundaries throughout the innovation process" (Lichtenthaler, 2011). When focusing on the influence of open innovation on the internal development of business innovations, the inbound open

innovation types, i.e., sourcing knowledge, ideas, or inventions from the external environment (Dahlander and Gann, 2010), are of particular relevance. They manifest themselves – e.g., in a search behavior – when it comes to innovation initiatives that include various external sources of knowledge and increased collaboration with external partners (e.g., Laursen and Salter, 2006). This broadened access to external knowledge is reported to have positive impacts on the performance of both the innovation process and its outcome (e.g., Davey et al., 2010). Nevertheless, it is a complicated endeavor to identify and transport valuable external knowledge to the organization, especially from distant sources, and make mindful use of it (Salge et al., 2012). After analyzing literature on open innovation, West and Bogers (2014) derive a four-phase process model of firms leveraging external sources of innovation. The first phase focuses on the search for and acquisition of external knowledge. In the second phase the acquired external knowledge is integrated into the focal firm. Afterward, in phase three, the integrated knowledge becomes commercialized into, e.g., new business models. In parallel to these three phases, there is a fourth one dealing with interactions among the respective partners and including aspects such as co-creation, reciprocal information exchange, and participation in innovation ecosystems (West and Bogers, 2014). It becomes apparent that the integration phase is a key bottleneck to profiting from external knowledge. The concept of absorptive capacity is an instance of this phase and has been described as contributing to the success of open innovation (e.g., Newey, 2010) by enabling firms to "capitalize on external sources of innovations" (West and Bogers, 2014).

Cohen and Levinthal (1990) define absorptive capacity as the "ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends" (Cohen and Levinthal, 1990). This concept has further been described as building upon knowledge gathered in the past (Zahra and George, 2002). Because of this path dependency, absorptive capacity has often been conceptualized as an asset, i.e., a stock of knowledge gathered in the past. However, in their guidelines concerning absorptive capacity in IS research, Roberts et al. (2012) recommend viewing it as a capability because then the process of knowledge absorption can be captured as well (Roberts et al., 2012). Prior research has defined several kinds of absorptive capacity according to, e.g., the respective field of knowledge that is to be addressed, (e.g., Newey, 2010; Weigelt and Sarkar, 2012) or different phases in the innovation process (e.g., Lichtenthaler and Lichtenthaler, 2009). Furthermore, Zahra and George (2002) describe two subsets of

absorptive capacity: “Potential capacity comprises knowledge acquisition and assimilation capabilities, and realized capacity centers on knowledge transformation and exploitation” (Zahra and George, 2002). Concerning the relation of organizational factors and absorptive capacity, Jansen et al. (2005) have shown that cross-functional interfaces, participation in decision making, and job rotation increase potential, while connectedness and socialization tactics improve realized absorptive capacity.

According to Lane et al. (2006), absorptive capacity generates two types of output: knowledge outputs and commercial outputs. While knowledge outputs encompass, e.g., technical or scientific knowledge, commercial outputs comprise new products, services, business models, or patents. Both output types influence firm performance and, due to the path dependency of the construct, a firm’s future absorptive capacity (Lane et al., 2006). Prior research is relatively consistent regarding the impact of absorptive capacity on performance: “Absorptive capacity amplifies the benefits of external innovation sourcing both on innovativeness and on financial performance” (West and Bogers, 2014).

However, although open innovation and absorptive capacity have been reported to positively influence outcome measures, their impacts on internal innovativeness are not well understood (West and Bogers, 2014). When Chesbrough (2003) introduced the concept of open innovation, it included the assumption that openness in innovation processes would spur internal innovations by delivering valuable insights and knowledge (Faems et al., 2010). Since then, however, this connection has not been subject to much research. Existing work on the issue has produced conflicting results. While Faems et al. (2010) find a positive impact of the diversity of technology alliances a firm pursues on its internal innovation efforts, West and Bogers (2014) state, “Adopting an inbound open innovation strategy could allow financially conscious managers to use it as an excuse to cut internal innovation resources, subject to the need to maintain enough absorptive capacity to evaluate and integrate external innovations” (West and Bogers, 2014). Thus, an emphasis on external innovation collaboration may hinder internal departments or employee’s willingness to be innovative on their own.

2.3 Hypothesis Development

In this paper, we aim to examine the influence of firm openness in innovation and the IT department’s absorptive capacity on the individual entrepreneurial behavior of IT professionals. Through this approach, we examine how organizational and departmental

aspects, as perceived by the individual, influence individual innovation behavior. With this focus, we follow West and Bogers (2014), who maintain that "more research is needed on individuals as sources of innovation" (West and Bogers 2014). Concerning the literature on open innovation, Salter et al. (2014) identify a void at the individual level, even though individuals are, according to the authors, the ones executing open innovation. However, they "need to be able to take advantage of the knowledge they obtain from external sources" (Salter et al., 2014) by organizational circumstances. Moreover, we follow Lane et al. (2006) in the sense that knowledge acquisition and integration at the firm level is complemented by the individuals when it comes to making use of it, especially in innovation: "In short, it is the firm's individual members who add the creativity needed to help the firm uniquely create value from new knowledge" (Lane et al. 2006). Figure 4 depicts our research model[1]. In the following, we will develop our hypotheses.

There exist various theories to explain human behavior (Venkatesh et al., 2003; Venkatesh and Brown, 2001). As entrepreneurial behavior is an intentional act, prior research has found intention-based theories to be of superior explanatory value (Krueger et al., 2000). Therefore, we draw on the well-established theory of planned behavior (Ajzen, 1991). This theory aims to explain individual behavior through an individual's intention toward the respective behavior and the "perceived ease or difficulty of performing the behavior" (Ajzen, 1991), a concept referred to as perceived behavior control. Within the frame of reference of our study, this is of particular importance. Individual entrepreneurial behavior, especially within a firm, does not solely depend on the personal intentions of employees to do so; instead, the organizational surroundings, such as the time available and management support, influence the employees' perception of being able to act entrepreneurially. The theory of planned behavior accounts for this aspect with the construct of perceived behavioral control and by doing so extends the theory of reasoned action (Fishbein and Ajzen, 1975). Beside the fact that the theory is "one of the most influential theories in explaining and predicting behavior, and it has been shown to predict a wide range of behaviors" (Pavlou and Fygenson, 2006), Kautonen et al. (2013), employing a longitudinal empirical investigation, have proven the theory's significant ability to predict the entrepreneurial behavior of individuals (Kautonen et al., 2013).

[1] To keep the illustration comprehensible, we have not depicted the direct effects of external orientation and information exchange on individual entrepreneurial intention and perceived behavioral control. This also applies to Figure 5.

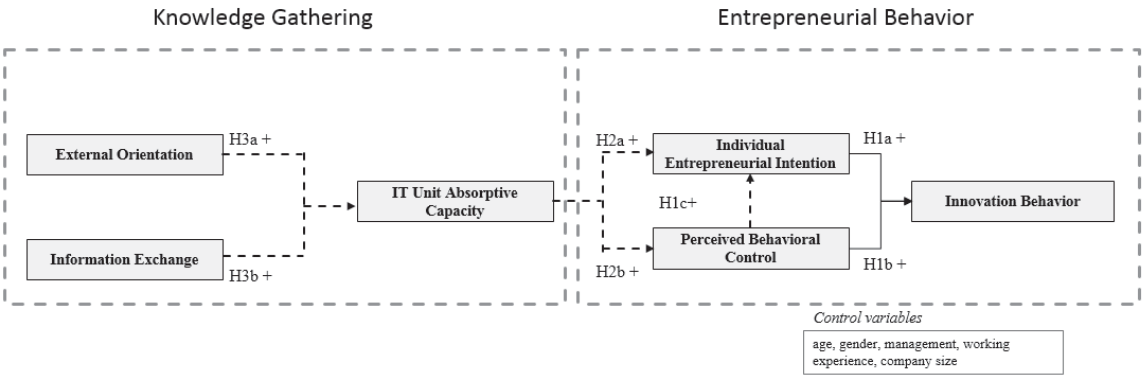

Figure 4 - Research model

In this study, we want to focus on how the factors that influence entrepreneurial behavior – according to theory of planned behavior – are impacted by openness and absorptive capacity as perceived by the individual. Therefore, we abstract from the individual's subjective norm and attitude against entrepreneurial behavior, which, according to theory, only have an indirect effect on the actual behavior (Ajzen, 1991). Following the theory, the innovation behavior of IT professionals should depend on the individual's intention toward pursuing business innovations as well as his or her perception of the available resources and opportunities (Ajzen, 1991). Furthermore, these two influencing factors should be interdependent, as perceived behavioral control influences the individual intention (Ajzen, 1991). Therefore, we propose the hypotheses below:

> *H1a: Individual entrepreneurial intention positively influences the innovation behavior.*
>
> *H1b: Perceived behavioral control positively influences the innovation behavior.*
>
> *H1c: Perceived behavioral control positively influences individual entrepreneurial intention.*

As mentioned in the theory section, absorptive capacity describes an organization's ability to leverage external knowledge. Prior research has hinted that an emphasis on external sources of knowledge might diminish internal innovativeness (West and Bogers, 2014; Xu et al., 2013). Transferred to our focus, if an IT unit intensively integrates knowledge from outside the firm, individual employees could be less motivated to act entrepreneurially because they might feel it unnecessary. Moreover, as stated above, if resources are restricted, they might perceive that there are not enough resources to foster their own

innovations, due to the activities undertaken to acquire knowledge from external sources. However, it is not yet clear whether external engagement in innovation supplants or drives internal innovativeness (West and Bogers, 2014). One could also argue that, in contrast, external knowledge spurs the individual innovativeness of IT professionals because it stimulates their creativity, alertness, and opportunity recognition (Sambamurthy et al., 2003). Moreover, external knowledge and ideas can be perceived as an essential resource for identifying, e.g., unserved customer demands. Despite the gap in literature on the relationship of absorptive capacity as an organizational capability and individual behavior (Hotho et al., 2012), empirical evidence suggests that externally sourced knowledge positively influences individual innovativeness (Tortoriello, 2006). As absorptive capacity builds upon previously gathered external knowledge (Lane et al., 2006), a high level of this capability indicates a large stock of externally sourced knowledge, which in turn might foster individual innovativeness. Therefore, we propose the following hypotheses:

H2a: IT unit absorptive capacity positively influences individual entrepreneurial intention.

H2b: IT unit absorptive capacity positively influences perceived behavioral control.

Although we follow Tortoriello (2006) in assuming a positive effect of openness to external sources on internal innovativeness, prior research has found differentiated results on this matter (e.g., Laursen and Salter, 2006), hinting that there might be other factors influencing the actual impact. We suggest that the IT unit's absorptive capacity influences the relationship between firm openness and information exchange as well as the entrepreneurial behavior of IT professionals. The same applies to information exchange with external partners. In doing so, we follow Salter et al. (2014): "Interaction with external parties to access knowledge may require effort to translate and integrate it, and it may be less immediately obvious how it fits with the organization's objectives and expertise" (Salter et al., 2014). Due to the importance of absorptive capacity, we investigate its antecedents as well as its mediating effects.

Following the four-phase model of open innovation by West and Bogers (2014), absorptive capacity represents the integration of externally sourced knowledge into the focal firm. This phase is in turn influenced by the obtaining and interaction phases. To keep our model simple, we operationalized each phase with one construct: external orientation (Zahra et

al., 2004) for the obtaining phase and information exchange (Rai et al., 2012) for interaction phase. Concerning the former, prior research has explained that firms source ideas from the external environment by collaborating with various stakeholders, such as customers, suppliers, competitors, or universities (West and Bogers, 2014). These learning relationships, according to the process model of Lane et al. (2006), influence the capability of absorptive capacity. Moreover, due to the path dependency of the product, each outcome of learning from external sources, i.e., the knowledge gathered, influences absorptive capacity in turn. Concerning information exchange, Love et al. (2014) maintain that openness to external knowledge sources in innovation processes includes reciprocal information processing. The authors demonstrate through their empirical investigation that these exchange experiences, however, have the potential to not only benefit the innovation process but also create a learning effect on the ability to profit from external linkages for future innovation processes (Love et al., 2014), thus driving absorptive capacity. Therefore, we propose the following hypotheses[2]:

H3a: External orientation positively influences IT unit absorptive capacity.

H3b: Information exchange positively influences IT unit absorptive capacity.

M1: IT unit absorptive capacity at least partially mediates the positive effects of external orientation on individual entrepreneurial intention.

M2: IT unit absorptive capacity at least partially mediates the positive effects of external orientation on perceived behavioral control.

M3: IT unit absorptive capacity at least partially mediates the positive effects of information exchange on individual entrepreneurial intention.

M4: IT unit absorptive capacity at least partially mediates the positive effects of information exchange on perceived behavioral control.

[2] To decrease complexity, we have not separately added hypotheses on the direct effects of external orientation and information exchange on individual entrepreneurial intention and perceived behavioral control as these are already included in M1-M4.

2.4 Research Design and Method

2.4.1 Data-collection procedure and sample

We started an online survey, conducted in both German and English, in February 2014 to test our research model. The survey in English was developed, and an independent translator translated the German version. To establish conceptual consistency, another translator then translated it back to English. We collaborated with a panel provider that hosted a panel with workers at an IT department in non-IT firms in the UK and Germany. The initial sample consisted of 526 participants, with 372 completing the survey (71%). We had to remove 18 of these because of implausibly short handling times. Table 11 provides the demographics of our sample.

Total Sample	***n* = 354**	**Percentage**
Gender		
Male	245	69%
Female	109	31%
Age		
19–25	43	12,1%
26–35	153	43,2%
36–45	88	24,9%
46–55	50	14,1%
56–65	19	5,4%
66 and over	1	0,3%
Management		
Yes	310	88%
No	44	12%

Total Sample	***n* = 354**	**Percentage**
Working Experience		
< 2 years	20	6%
3–5 years	53	15%
6–10 years	94	27%
11–15 years	63	18%
16–20 years	46	13%
> 20 years	78	22%
Company size		
< 50	42	12%
50–99	39	11%
100–499	86	24%
500–999	75	21%
1.000–2.499	46	13%
2.500–9.999	33	9%
>10.000	33	9%

Table 11 - Sample demographics

2.4.2 Measurement of constructs

We used standard psychometric scale-development procedures. Our study consists of validated scales when possible, and we adapted some scales to our research context. In a

first step, we evaluated our scales based on the feedback from practitioners and scholars in the area of corporate entrepreneurship and motivation research. Following their recommendations, we removed some of the items to ensure the face and content validity of the scales (Hardesty and Bearden, 2004; Moore and Benbasat, 1991). To evaluate and enhance our reflective measures, we also conducted two pilot studies (n = 23). After the second study, the reliability of scales suggested that our survey was ready for a larger study (Brown and Venkatesh, 2005). All items were evaluated using a seven-point Likert scale with the anchors "strongly disagree" (1) and "strongly agree" (7). The psychometric properties and final items are presented in Table 12.

Construct (Source)	**Items**	**Factor Loading**
Perceived Behavioral Control (Bamberg, 1999)	If I wanted to, I would be able to develop innovative business ideas.	.880***
	I have the necessary abilities to develop innovative business ideas.	.885***
	Developing innovative business ideas is easy to me.	.860***
IT Unit Absorptive Capacity (Pavlou and El Sawy, 2006)	Identify and acquire internal (e.g., within the department) and external (e.g., market) knowledge.	.862***
	Developing new knowledge or insights that have the potential to influence new products or services development.	.874***
	Effective routines to identify, value, and assimilate new information and knowledge.	.830***
	Transforming existing information into new knowledge.	.840***
	Exploitation of internal and external information and knowledge into our applications.	.793***
Information Exchange (Rai et al., 2012)	Our IT-service provider and we provide each other with sufficient information to perform the process.	.877***
	Our IT-service provider and we successfully exchange information with each other.	.882***
	Our IT-service provider and we communicate well with each other and discuss at eye level.	.884***
Individual Entrepreneurial Intention (de Jong, 2011)	If I identify a new business opportunity, I would promote and champion my idea to co-workers and superiors.	.795***
	If I had an idea for innovations, I would try to assess its long-term opportunities and threats for the company.	.837***
	I have always wanted to implement innovations by myself.	.773***

	If I had the opportunity, I would like to develop a product or service on my own (or in a team).	.644***
	I intend to develop innovative ideas in the company's core business and implement them within the company in the future.	.808***
	I think that in the future I will develop innovative ideas in the company's core business and implement them within the company more often.	.841***
External Orientation (Zahra et al., 2004)	My firm tracks changes in its markets on a regular basis.	.860***
	My firm values working with key customers and learning from them.	.870***
	My firm values working with key suppliers and learning from them.	.863***
	My firm values learning from the actions of its competitors.	.898***
Innovation Behavior (Amo and Kolvereid, 2005)	To which extent do you contribute to new product development in the organization where you are employed?	.839***
	To which extent do you contribute to the development of new product-market combinations in the organization where you are employed?	.886***
	To which extent do you contribute to development projects in the organization where you are employed?	.827***
	To which extent do you contribute to the development of new venture ideas in the organization where you are employed?	.880***
	To which extent do you contribute to the development of new markets for the organization where you are employed?	.839***
Note: * p < .05; ** p < .01; *** p < .001;		

Table 12 - Scale

2.5 Analysis and Results

We used structural equation modeling to validate our research model, employing SmartPLS version 2.0.M3 (Ringle et al., 2005) to apply a component-based partial least squares (PLS) regression. In a first step, we assessed the psychometric properties of the measurement model; afterward we verified our hypotheses using the structural model, following the two-stage procedure by Anderson and Gerbing (1988).

2.5.1 Assessment of measurement model

Conducting reliability and validity tests according to the guidelines of Gefen and Straub (2005), we assessed our reflective variables. Following Chin (1998), we set the recommended threshold to .707. Table 12 reveals that all but one of our reflective items

loaded significantly on their constructs with values higher than the required .707, and none of our items loaded on the construct below the cutoff of .50. Furthermore, we set the threshold of composite reliability (CR) to the recommended .70 (Gefen and Straub, 2005); all of our constructs exceeded this threshold (see Table 13). The indicator and construct reliability could be tested in a positive way. We assessed convergence validity by examining the constructs' average variances (AVE). Following Bhattacherjee and Premkumar (2004), we set the threshold to .50; each construct was above it. As a final step, we applied the discriminant validity using the criterion of Fornell and Larcker (1981): Discriminant validity is established when any squared correlation between any two items is lower than the corresponding AVE. The independent and dependent variables came from the same respondent. To test for common method bias we performed the marker variable test (Lindell and Whitney, 2001) and Harman's single-factor test (Podsakoff et al., 2003). Both tests indicate that there is no common method bias that could threaten our study's validity.

Construct	Range	Mean (STD)	CR	AVE	CA	INB	IEI	PBC	ITAC	EXO	INE
INB	1–7	5.16 (1.24)	.93	.73	.91	**.85**					
IEI	1–7	5.33 (1.21)	.91	.62	.87	.59	**.79**				
PBC	1–7	5.27 (1.12)	.91	.77	.85	.63	.55	**.87**			
ITAC	1–7	5.43 (1.06)	.92	.71	.90	.65	.67	.72	**.84**		
EXO	1–7	5.38 (1.17)	.93	.76	.90	.60	.61	.65	.71	**.87**	
INE	1–7	5.37 (1.24)	.91	.78	.86	.52	.60	.55	.62	.62	**.88**

Note: STD = standard deviation; CR = composite reliability; AVE = average variance extracted; CA = Cronbach's alpha; INB = innovation behavior; IEI = individual entrepreneurial intention; PBC = perceived behavioral control; ITAC = IT unit absorptive capacity; EXO = external orientation; INE = information exchange; bold diagonal elements represent the square root of AVE.

Table 13 - Construct correlations

2.5.2 Testing the structural model

As pointed out earlier, we used structural equation modeling (PLS) to validate our research model. We applied bootstrapping with a sample of 3,000 to test the significance of the path coefficients. Our model supports the hypothesized positive effects of individual entrepreneurial intention and perceived behavioral control (H1a, H1b) on innovation

behavior (see Figure 5[3]). We also found support for the direct effect of IT unit absorptive capacity on individual entrepreneurial intention and perceived behavioral control (H2a, H2b). Our model could also validate the relationship and significant influence of external orientation and information exchange on the IT unit absorptive capacity.

Hypotheses H1a (β = .314, p > .001) and H1b (β = .424, p > .001) were confirmed by the model estimations. Therefore, we can state that individual entrepreneurial intention and perceived behavioral control positively influence the innovation behavior of IT department employees. Hypothesis H1c (β = .352, p > .001) is also statistically supported by our model. Hence, we state that perceived behavioral control positively influences individual entrepreneurial intention. The influence of IT unit absorptive capacity on individual entrepreneurial intention was tested to be significant, supporting H2a (β = .415, p > .001), as was the positive influence on perceived behavioral control, backing H2b (β = .720, p > .001). The statistically significant influence of external orientation and information exchange is also supported by our data. Therefore, we state that external information, H3a (β = .536, p > .001), as well as information exchange, H3b (β = .289, p > .001), positively influence IT absorptive capacity.

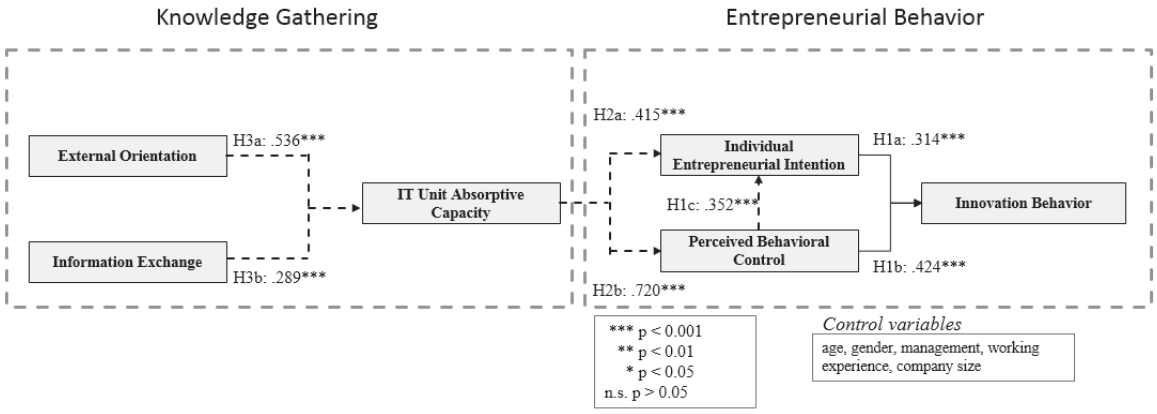

Figure 5 - Results

2.5.3 Mediation analyses

As also tested our model for the hypothesized mediating effect of IT absorptive capacity. To this end, we followed the procedures of Baron and Kenny (1986), which require the

[3] The coefficients for the direct effects of external orientation and information exchange on individual entrepreneurial intention and perceived behavioral control as well as the mediating effects of IT unit absorptive capacity are presented in Table 4 and were left out of Figure 2 to increase the comprehensibility and reduce the complexity of the figure.

fulfillment of three conditions. To verify the mediating effect, the first condition is that the independent variable (IV) must account for variations in the dependent variable (path c). As a second condition, the variation in the mediator to the dependent variable (path b) must be significant. The final condition is that there must be significant variation in the IV to the mediator (path b). If all three conditions are met and there is a smaller effect of the IV on the dependent variable while checking for the mediation (path c') compared to path c, there is mediation present. To determine whether this mediation is partial or full, we must establish whether path c' is insignificant; we will have a full mediation if path c' is statistically insignificant and otherwise a partial mediation (Baron and Kenny, 1986). To test the significance of the mediation, we performed the Sobel test (Sobel, 1982), checking the indirect effects to assess whether inserting the mediator into the model decreases the IV's effect. We present our results in Table 14. Finally, we verified the strength and significance of the indirect effect, following Preacher and Hayes (2004), by bootstrapping the indirect path. All results verify our findings, with $p < .001$ for the indirect effect of the mediation analysis.

Hypotheses	**IV**	**DV**	**MV**	**Model II**			**Model I**	**Sobel's Test**	**Mediation**
				a	b	c'	c	Z	
M1	EXO	IEI	ITAC	.714***	.476***	.272***	.612***	6.329 ***	Partial
M2	EXO	PBC	ITAC	.714***	.528***	.269***	.646***	4.197 ***	Partial
M3	INE	IEI	ITAC	.621***	.554***	.189***	.536***	6.746 ***	Partial
M4	INE	PBC	ITAC	.621***	.612***	.174***	.557***	2.418 ***	Partial
Note: IV = independent variable; DV= dependent variable; Model I: without controlling for the mediator (EI); Model II: with controlling for the mediator; Path a: IV -> mediator; Path b: mediator -> DV; Paths c and c': IV-> DV; * $p < .05$; ** $p < .01$; *** $p < .001$.									

Table 14 - Mediation analyses

2.6 Discussion and Implications

Due to the increasing penetration of IT into everyday life (Yoo, 2010), the role of IT in businesses is changing. When businesses innovate their products, services, or business models, they must deal more and more with IT, no matter the industry to which they belong (Nambisan, 2013). To meet this challenge, IT departments and their employees must therefore contribute to business innovations. However, the innovation ecosystem has recently been reported to be changing. The emergence of digital eco-systems and platforms

creates an innovation climate in which collaboration and co-creation with various external partners and customers – openness – is necessary (El Sawy and Pereira, 2013). This use of external innovation sources, however, has been attributed as having the potential to hinder internal innovativeness. Such a development is extremely dangerous; in times when IT innovations have become a differential factor in competition, it is necessary for firms to keep or develop internal IT-innovation competence to avoid being disrupted from the market. Furthermore, in digital ecosystems, collaboration partners are often also competitors (Henningsson and Hedman, 2014). Sole reliance on the innovative power of external partners is therefore a risky endeavor.

In this paper, we conducted a survey with 354 employees of IT departments in non-IT firms to investigate how openness toward the external environment and the absorptive capacity of the IT unit, both as perceived by the individual, influence the innovativeness of IT professionals. Our findings indicate that openness toward the external environment, i.e., customers, suppliers, competitors, and reciprocal information exchange with partners, has a positive and significant influence on the IT unit's absorptive capacity. This is in line with prior research on the antecedents of absorptive capacity (Lane et al., 2006). Bidirectional learning from external sources increases not only the knowledge stock but also the capability to transform the external knowledge for the firm's own commercial purposes. As the mediation analysis (see Table 14) indicates, information exchange and the external orientation are partially mediated by the IT unit's absorptive capacity. This hints at the particular importance of absorptive capacity when dealing with external sources in the innovation process. While in general open innovation has been found to have positive effects on innovation outcomes in recent works (e.g., Davey et al., 2010), its impact on internal innovativeness was rather unclear in prior literature (e.g., Laursen and Salter, 2006). Our findings indicate, in line with Chesbrough (2003), that the external knowledge accessed by openness fosters innovations from internal departments and employees. The more developed a department's absorptive capacity is, the more this seems to be true for the respective department – IT in our case. The mediating effect indicates that access to external knowledge is just one part of the story. Particularly when this knowledge comes from diverse and distant sources and is thus fundamentally different – as is increasingly the case for digital innovations (Yoo et al., 2012) – the ability to integrate, translate, and learn from it becomes essential to profiting from open innovation (Salter et al., 2014). Absorptive capacity by itself was found to positively influence both individual

entrepreneurial intention as well as perceived behavioral control. Hence, IT professionals are motivated to act in an entrepreneurial way and feel an increased ability to do so if there is a high level of absorptive capacity in the IT department. This might be explained as follows: Entrepreneurial behavior of employees is a creative process whereby knowledge from external sources must be integrated with the individual's creative ideas to actually induce business innovations (Lane et al., 2006; Sambamurthy et al., 2003). The openness of the organization increases the knowledge inflow, which in turn is amplified or receives an "added value" through absorptive capacity. When this valuable and enhanced knowledge reaches the employee, he or she feels empowered to act in an entrepreneurial way because his perception of market opportunities is increased. Consequently, the employee might sense increased prospects for acting entrepreneurially and an enhanced probability of being successful with it. As suggested by prior literature (Ajzen, 1991), we found individual intention and perceived behavioral control to positively influence actual individual behavior. Our findings also support the positive influence of perceived behavioral control on the individual's intention. Nevertheless, our findings indicate that there could be additional factors to consider when it comes to entrepreneurial behavior, such as the incentives a firm employs to motivate IT entrepreneurial behavior (see Kruep et al., 2014).

In sum, we can negate a negative impact of external orientation on internal innovativeness (West and Bogers, 2014) – at least for our context. On the contrary, external information and knowledge seem to fuel the innovativeness of the employees or "feed the internal innovation machine", especially if the IT unit has developed a high level of absorptive capacity. Thus, we provide more clarity to the relationship between external and internal sources of innovation. Moreover, our study has important implications for the information systems research community. We are among the first to investigate the influence of firm openness on internal IT innovations. As described in the background section, openness will be an essential part of future digital innovation ecosystems. However, as prior research has revealed, this aspect may also have negative consequences on internal innovativeness. With our research we reveal an important contingency when it comes to profiting from openness: the absorptive capacity of the IT department. However, future research should also investigate the influence of other organizational and individual factors on the ability to bridge the gap between external and internal innovation. Furthermore, the impact of

different approaches to digital business strategy (Bharadwaj et al., 2013) on the innovation activities of IT departments is of particular interest.

Our study has also implications for practitioners. If business managers want to spur IT innovations, opening up the innovation channel is a good idea. They should support interaction with diverse stakeholders. Moreover, they should support reciprocal information exchange. However, the aim of openness should always be to benefit internal innovativeness because it is the source of future profits. Therefore, it is not enough to just be open; to achieve the best possible effects on the innovativeness of IT departments and their employees, they should foster the department's absorptive capacity.

2.7 Limitations

This paper provides insights into the importance of external knowledge within the firm's internal innovation process. However, we must mention some limitations. First, the study was conducted in Western Europe. Therefore, cultural impacts from other regions are not considered in this study. As pointed out by prior research (e.g., Lee and Peterson, 2000), regional and cultural factors (e.g., power distance, uncertainty avoidance) influence entrepreneurial orientation. Moreover, the sample includes a large proportion of respondents in the age range of 26 to 45. These sample characteristics may reduce the generalizability of our findings. To address this limitation, further research should validate our findings in other cultural areas and with a sample balanced across all ages. We further encourage researchers to find moderating effects on the knowledge-gathering process, thus extending our model. Here, especially in innovation contexts, the role of cross-functional integration mechanisms (e.g., Jansen et al., 2005) should be further investigated, which would help practitioners support their employees in this area. Second, as prior literature suggests (e.g., West and Bogers, 2014), there would have been several other possibilities for the operationalization of the obtaining and interaction phases of open innovation. As described above, we chose one specific construct for each phase to keep the model simple. Here, future research could investigate the influence of other constructs and thus test the reliability of our findings.

2.8 Conclusion

In the future, if businesses innovate, IT will play a substantial role. Furthermore, innovating with IT will most likely imply opening up the innovation channel and

collaborating with various kinds of external partners as digital platforms and ecosystems arise. According to prior research, emphasizing external innovation collaboration bears the risk of inhibiting internal innovations. Business managers are thus confronted with a dilemma: On the one hand, they must collaborate with external partners on IT innovations; on the other hand, they need to build the entrepreneurial role of their IT departments and their respective employees. Therefore, the question arises of how the focus on external innovation sources and the emphasis on the internal innovativeness of IT professionals relate to each other. With our empirical analysis, we provide evidence that openness fosters the entrepreneurial behavior of IT workers. However, this impact is amplified by the absorptive capacity of the IT unit. With this capability, valuable external knowledge can be integrated, thus driving both IS professionals' motivation to act entrepreneurially and their perceived ability to do so. Our study therefore implies that managers should support openness to gather external knowledge from various sources and foster the absorptive capacity of the respective IT unit to be best prepared for future challenges in IT innovation.

3 Impacts of Social Interaction on Employees' Entrepreneurial Intention

Title of Article	Start social – IT outsourcing as a key factor for IT innovations
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Published	Multikonferenz Wirtschaftsinformatik 2016, Ilmenau
Abstract	The role of IT innovation has become more of a focus in the past decade. Traditional industries are undergoing a shift in their innovation strategies. For example, automotive manufactures like Volkswagen are calling for collaboration with IT firms such as Apple and Google to face the challenge of new innovation in their core businesses. IT managers must therefore prepare their employees for this new role. In fast changing areas such as IT, external partners can play a particularly important role by delivering information and resources. Therefore, managers should enter into strategic alliances with innovation-outsourcing partners and build upon interfirm networks. This paper applies the Social Cognitive Theory to determine the importance of social interactions between outsourcing partners and internal IT departments. An empirical analysis is provided to evaluate the research model. The results indicate that social interactions, shared vision, reciprocity, and trust play key roles in the innovation process in interfirm networks.

Table 15 - Fact sheet of publication no. 2

3.1 Introduction

The role of IT in non-IT firms has changed in the past decade. While IT was formerly just a supporting unit for everyday work, it is now one of the main drivers within the innovation process. Even traditional industries, such as toy manufacturers or the automobile industry, are being challenged to embed new digital technologies into their products (Nambisan, 2013), thereby raising the value of their core products. Martin Winterkorn, CEO of Volkswagen AG, calls for cooperation with Apple and Google as partners in the innovation process. To achieve such collaboration, however, it is necessary to prepare the internal IT department for the challenge of interfirm networking.

While the field of IT and firm performance has been widely examined, there is a lack of research in the area of IT and firm innovation performance (Han and Ravichandran, 2006; Pavlou and El Sawy, 2006). Why are some firms more innovative than others? What are the differences among them? In this paper an innovation is defined as a new or improved version of a product (e.g., hybrid car), service (e.g., entertainment system in a car), process (e.g., shorter delivery times through IT integration with suppliers), or business model (e.g., car-sharing services) within the core business of a non-IT firm. The focus of this paper lies on the relationship between employees of the in-house IT and those of the outsourcing partners. Would it make a difference if they had closer connections to each other? This paper addresses the following question:

How important are social interactions between internal IT employees and the outsourcing partners in the process of internal innovation?

Information technology outsourcing is one of the most common business strategies today. This strategy promises cost savings, more flexibility, and improvements in service levels (Belcourt, 2006; Dube and Kaplan, 2010). Unlike in past years, research now distinguishes between two types of outsourcing: low-cost-oriented outsourcing for reasons such as those mentioned above and innovation-oriented outsourcing (Bengtsson et al., 2009). As the challenge for today's businesses is to innovate, Breunig and Bakhtiari (2015) find that the likelihood for innovations in a firm in the following years is 5% higher if firms innovate and outsource rather than focusing on innovation alone. To take advantage of this new chance for innovations, IT departments must open their innovation channels and get in touch with their outsourcing partners (Yoo et al., 2012).

This new challenge also brings new problems to department leaders. IT managers find themselves in a dilemma: they must open up and collaborate with external partners while also protecting themselves from espionage, as collaboration partners are often also competitors (Henningsson and Hedman, 2014). Hanelt and Kruep (2015) find that managers "[…] should support openness to gather external knowledge from various sources" to prepare the IT unit for future challenges. Their findings reveal that the ability to absorb and apply new knowledge, represented by the absorptive capacity, is a key factor to innovate with the support of people from their environment. This paper will focus on various factors that are important for innovating with the help of outsourcing partners. Furthermore, it sets up a framework to evaluate the influence of social interaction combined with a shared vision on the innovation processes.

The following section develops the research model and hypotheses.

3.2 Hypotheses Development

While prior research suggests that customers play a key role within the innovation process (Prahalad and Krishnan, 2008; Sawhney et al., 2005) this paper focuses on the role of interactions between the employees of IT departments and the employees of outsourcing partners. The influence of these social interactions on the innovation behavior of firms' individuals will be examined, as following Lane et al. (2006), the value of knowledge is created by individuals.

In this paper an IT-based innovation is defined as a combination of business capabilities combined with software and/or hardware to optimize or create a new process, service, or product within the core business of the firm (Mahnke et al., 2006)

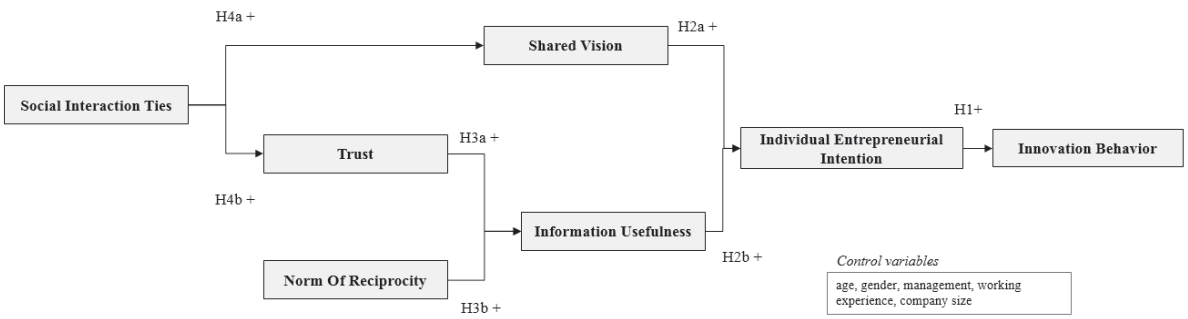

Figure 6 - Research Model

The focus of this study is to evaluate the impact of knowledge transfer and collaboration between IT outsourcing partners and employees of in-house IT departments in non-IT firms on the innovation behavior of each member of the department. It will provide insights into the innovation process and the role of external partners, thereby adding knowledge to the area of interfirm innovation. The field of innovation lacks information on the role of individuals in this process (West and Bogers, 2014).

Innovation behavior describes the extent to which an employee is part of a company's innovation process. Following Ajzen (1991), individual entrepreneurial intention is one of the influencing factors of innovation behavior, besides the perception of the available opportunities and resources. Therefore I propose a first hypothesis:

H1: If the individual entrepreneurial intention of an employee is higher, then innovation behavior will be higher.

Social Cognitive Theory

Social cognitive theory reveals that social networks and the cognition of a person shape a person's behavior. People who are connected in strong community and social interaction ties have the best conditions to exchange information and knowledge with other people in their network (Snowden, 1998; Yli-Renko et al., 2001). The suitable exchange of information is particularly important for IT departments. While product innovation in the IT sector is becoming very fast, one of the main tasks for companies is to be innovative in order to remain competitive on the market (Laursen and Salter, 2006; Davey et al., 2010). Value creation in traditional industries depends on the exchange and combination of resources (Ghoshal and Moran, 1996); this idea can be transferred to the innovation process. Tsai and Ghoshal (1998) find that a greater exchange and combination of resources in intrafirm networks leads to improved product innovation performance. The shared vision represents the aspiration and collective goals (Tsai and Ghoshal, 1998) of the IT-outsourcing partner's co-workers and employees from the firm's internal IT department. Shared vision is found to be an important part in the process of sharing and exchanging resources because the alignment of goals and interests makes it easier to see the potential for innovation. Thus, I suggest the following:

H2a: Outsourcing partners and internal employees sharing the same vision positively influences the employees´ individual entrepreneurial intention.

As this study focuses on the innovation of IT departments, one of the most important resources is information. Common constructs such as absorptive capacity have been validated as important factors in the learning process of IT departments in the process of innovation (Hanelt and Kruep, 2015). This study used information usefulness as the criterion for a good exchange of information between the internal IT and external partners. For employees in the innovation process, especially in a fast-changing sector like IT, it is important to obtain knowledge in the right way. Hence I propose the following:

H2b: If the quality of information delivered by the outsourcing partners is high, it will positively influence the individual entrepreneurial intention of the employees.

Trust plays a key role in the interaction with interfirm networks, particularly in the case of information exchange within the innovation process. Both firms as well as individuals that open up and share secret information must trust that their partners will not use the information for self-interest. Trust can be seen as an antecedent to cooperation (Gulati, 1995; Ring and Van der Ven, 1994). Therefore, if both partners start a trustful cooperation, the quality of information exchange will increase because no one needs to withhold information or transmit false information. Hence, I state the following hypothesis:

H3a: If people have a trustful relationship, the usefulness and quality of information exchanged will be better than if there is no trust.

Another important factor in relationships is reciprocity. Bock et al. (2005) find that the attitude to share knowledge is positively related to the reciprocity within a relationship. Furthermore, social cognitive theory (Bandura, 1989) maintains that reciprocity is important for a good information exchange, explaining that information sharing should be a process of give and take – IT departments must open up and start interacting with their partners. Hence, I propose the following:

H3b: A higher degree of reciprocity positively influences information exchange and thereby the usefulness of information.

In the field of social interaction, prior research has shown that individuals interacting over a long period of time and having strong ties experience a stimulation of trust between each other (Gulati, 1995). If people start getting to know each other they will develop a concrete relationship and perceive their counterpart as trustworthy (Gabarro, 1978). Social interactions help to increase trust in the partner and to reach a common understanding of

goals and expectations, represented in this model by the shared vision. Transferred to the situation between employees and outsourcing partners, this means that a higher amount of social interaction alongside their work leads to improved knowledge transfer. Therefore I suggest the following two hypotheses:

H4a: The higher the amount of social interaction with the outsourcing partner, the better the common understanding of goals and expectations (shared vision) will be.

H4b: Social interaction ties will help generate a trustful collaboration.

3.3 Research Design and Method

3.3.1 Data-Collection Procedure and Sample

The research model was tested using an online survey started in February 2014. The survey was conducted in both German and English with non-IT firms in Germany and the UK. Conceptual consistency was guaranteed by having an initial translator translate the English version of the survey to German and then an independent translator translating it back to English. Collaboration with a panel provider ensured a representative sample. The first sample consisted of 526 participants from employees in IT departments of non-IT firms. Though 372 participants (71%) answered the questionnaire completely, 18 of these had to be removed because of implausibly short handling times. The demographic of the sample is shown in Table 16.

Total Sample	*n* = 354	Percentage
Gender		
Male	245	69%
Female	109	31%
Age		
19–25	43	12,1%
26–35	153	43,2%
36–45	88	24,9%
46–55	50	14,1%
56–65	19	5,4%
66 and over	1	0,3%
Management		
Yes	310	88%
No	44	12%

Total Sample	*n* = 354	Percentage
Working Experience		
< 2 years	20	6%
3–5 years	53	15%
6–10 years	94	27%
11–15 years	63	18%
16–20 years	46	13%
> 20 years	78	22%
Company size		
< 50	42	12%
50–99	39	11%
100–499	86	24%
500–999	75	21%
1.000–2.499	46	13%
2.500–9.999	33	9%
>10.000	33	9%

Table 16 - Sample Demographics

3.3.2 Measurement of Constructs

The constructs were measured using standard psychometric scale-development procedures. Each item was assessed on a seven-point Likert scale with the anchors “strongly disagree” (1) and “strongly agree” (7). As all items used were evaluated by prior research, they only needed to be adapted to the context of this study.

The scales were evaluated based on the feedback from interviews of practitioners and scholars in the area of IT innovation. To achieve face and content validity of the scales (Hardesty and Bearden, 2004; Moore and Benbasat, 1991), some items were reworded. The final items and the psychometric properties can be found in Table 17. To ensure the correct study design as well as to refine and evaluate the reflective measures, the study was then evaluating using two pilot studies (n = 23). The second study suggests that reliability for a larger study could be ensured (Brown and Venkatesh, 2005).

Construct (Source)	Items	Factor Loading
Individual entrepreneurial intention (de Jong, 2011)	If I identify a new business opportunity, I would promote and champion my idea to co-workers and superiors.	.787***
	If I had an idea for innovations, I would try to assess its long-term opportunities and threats for the company.	.834***
	I have always wanted to implement innovations by myself.	.774***
	If I had the opportunity, I would like to develop a product or service on my own (or in a team).	.641***
	I intend to develop innovative ideas in the company's core business and implement them within the company in the future.	.813***
	I think that in the future I will develop innovative ideas in the company's core business and implement them within the company more often.	.846***
Information usefulness (adapted from Lane and Lubatkin, 1998; Szulanski, 1995, 1996)	The new knowledge transferred from our IT service provider contributed a great deal to multiple projects.	.883***
	Our organization was very satisfied with the quality of the knowledge that our IT service provider provided.	.865***
	Our organization dramatically increased the perception about the efficacy of the knowledge after gaining experience with it.	.887***
	The transfer of knowledge from the IT service provider greatly helped our company in terms of actually improving our organizational capabilities	.852***
Innovation Behavior (Amo and Kolvereid, 2005)	To which extent do you contribute to new product development in the organization where you are employed?	.841***
	To which extent do you contribute to the development of new product-market combinations in the organization where you are employed?	.887***
	To which extent do you contribute to development projects in the organization where you are employed?	.827***
	To which extent do you contribute to the development of new venture ideas in the organization where you are employed?	.881***
	To which extent do you contribute to the development of new markets for the organization where you are employed?	.837***
Norm of reciprocity (adapted from Chen and Hung, 2010)	I know that co-workers of the IT-service provider will help me, so it's obligated and fair to help other members in this virtual community	.874***
	When I share knowledge to co-workers of the IT- service provider, I believe that the members in this virtual community would help me if I need it.	.883***
	When I share knowledge to co-workers of the IT-service provider, I believe that	.883***

	my queries for knowledge will be answered in future in this virtual community.	
Relational trust (adapted from Chen and Hung, 2010)	My relationship with co-workers of the IT-service provider are based on reciprocal faith and trustworthiness.	.862***
	Co-workers of the IT-service provider will not take advantage of others even when the profitable opportunity arises.	.861***
	Co-workers of the IT-service provider try hard to be fair in dealing with each other.	.864***
Shared Vision (Chiu, 2006)	Co-workers of the IT-service provider share the vision of helping others solve their professional problems.	.910***
	Co-workers of the IT-service provider share the same goal of learning from each other.	.904***
	Co-workers of the IT-service provider share the same value that helping others is pleasant.	.901***
Social interaction ties (Chiu, 2006)	I maintain close social relationships with some co-workers of the IT-service provider.	.803***
	I spend a lot of time interacting with some co-workers of the IT-service provider.	.876***
	I know some co-workers of the IT-service provider on a personal level.	.884***
	I have frequent communication with some co-workers of the IT-service provider.	.873***
Note: * p < .05; ** p < .01; *** p < .001;		

Table 17 - Scale

3.4 Analysis and Results

3.4.1 Assessment of Measurement Model

In the first step, a confirmatory factor analysis was conducted to preclude the possibility of cross loadings. The analysis revealed that all items do not load on any corresponding construct as significantly high as on their corresponding constructs. This indicates that construct and indicator reliability are valid. The average variance extracted (AVE) of each construct was examined, confirming that the AVE of each construct is much higher than the recommended threshold of 0.50 by Bhattacherjee and Premkumar (2004). Following the guidelines of Gefen and Straub (2005), reliability and validity tests were conducted to evaluate the reflective variables.

Table 17 shows that none of the reflective items loaded below the cutoff value of .50. All of the items load on the underlying construct much higher than the recommended threshold

of .707 (Chin, 1998). Gefen and Straub (2005) recommended a threshold of .70 for the composite reliability (CR); all items score higher. Finally, the Fornell and Larcker (1981) criterion was applied, allowing discriminant validity to be established, as the squared correlations between any two constructs are lower than the corresponding AVEs.

Construct	Range	Mean (STD)	CR	AVE	CA	INB	IEI	USE	SVE	RET	NOR	SIT
INB	1–7	5.16 (1.24)	.93	.73	.91	**.92**						
IEI	1–7	5.33 (1.21)	.91	.62	.87	.59	**.85**					
USE	1–7	5.22 (1.15)	.93	.76	.89	.57	.58	**.87**				
SVE	1–7	5.27 (1.16)	.93	.82	.89	.56	.57	.77	**.88**			
RET	1–7	5.23 (1.11)	.90	.74	.83	.54	.51	.73	.74	**.86**		
NOR	1–7	5.32 (1.15)	.91	.77	.85	.55	.53	.76	.81	.79	**.88**	
SIT	1–7	5.12 (1.22)	.92	.74	.88	.60	.49	.62	.68	.68	.69	**.86**

Note: STD: standard deviation; CR: composite reliability; AVE: average variance extracted; CA: Cronbach's alpha; INB = innovation behavior; IEI = individual entrepreneurial intention; USE = information usefulness; SVE = shared vision; RET = relational trust; NOR = norm of reciprocity; SIT = social interaction ties; bold diagonal elements represent the square root of AVE.

Table 18 - Construct Correlations

3.4.2 Testing the Structural Model

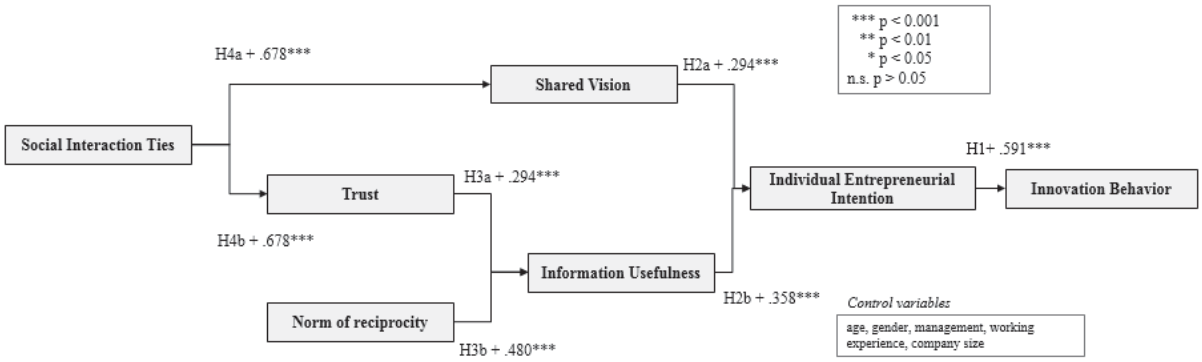

Figure 7 - Results

The research model was validated using structural equation modeling (PLS). By applying a bootstrapping with 3,000 samples and 354 cases, the significance of the path coefficients was calculated. Figure 7 reveals that the hypothesized positive direct effect of individual entrepreneurial intention on innovation behavior (H1) is supported. Support was also found

for the positive effects of shared vision and information usefulness on individual entrepreneurial intention (H2a, H2b). Furthermore, this study validates the positive influence of relational trust and norm of reciprocity on information usefulness (H3a, H3b) and the role of social interaction ties as a predecessor to shared vision and trust (H4a, H4b)

The statistically significant influence of individual entrepreneurial intention on innovation behavior (H1) was confirmed ($\beta = .591$, $p > .001$). Hence, if an employee has a higher amount of individual entrepreneurial intention, it will lead to greater innovation behavior.

The study supports H2a ($\beta = .294$, $p > .001$) as well as H2b ($\beta = .358$, $p > .001$), the positive influences of shared vision and information usefulness on individual entrepreneurial intention. This implies that shared vision and more useful information lead to a higher amount of individual entrepreneurial intention and thereby greater innovation behavior.

Based on the model estimations, hypotheses H3a ($\beta = .350$, $p > .001$) and H3c ($\beta = .480$, $p > .001$) were confirmed. Hence, both the relational trust as well as the norm of reciprocity positively influence the usefulness of information.

Support was also found for H4a ($\beta = .678$, $p > .001$) and H4b ($\beta = .678$, $p > .001$), indicating that better social interaction supports the establishment of a shared vision and a trustful relationship.

Common method bias was excluded using the recommended tests, as the independent and dependent variables are from the same questionnaires. The marker variable test (Lindell and Whitney, 2001) and the Harman's single-factor test (Podsakoff et al., 2003) reveal that there is no indication for common method bias.

3.5 Discussion and Implications

The changing role of IT is forcing non-IT companies to rethink the role of their IT departments, even in traditional industries with their expanding technological implementation. IT departments are transforming from mere supporting units towards being a source of innovation. IT features are being used increasingly to add value to products. The role of outsourcing partners is also changing. While prior outsourcing relationships were intended to lead to lower costs, more flexibility, or improved quality,

companies now are progressively converting their relationships to innovation-oriented outsourcing (Bengtsson et al., 2009).

To evaluate whether a higher degree of social interaction with these outsourcing partners has an influence on the innovation behavior of each member of the internal IT department, a study was conducted with 354 employees in IT departments of non-IT firms. The findings reveal that a higher degree of social interaction between the partners is an important starting point in the process of innovation. Due to the closer ties between the employees and the partner, each member of the relationship experiences a stimulation of trust (Gulati, 1995). They get to know each other and thereby start to believe that no member of the relationship would use information for their own advantage and for the disadvantage of the other partner. The results indicate that a close connection also helps to generate a common understanding of goals and expectations. Both factors are important for creating a climate of trust to share information and resources (Gulati, 1995; Ring and Van der Ven, 1994). The study also reveals that the quality and usefulness of information is higher if both the reciprocity and trust between outsourcing partners and internal IT are high. The higher quality and the common understanding of goals lead to a greater individual entrepreneurial intention and thereby a higher amount of innovation behavior.

This study has also some implications for practitioners. IT managers concerned with the role of innovators must overcome the fear of being open to external partners. If IT departments are to work innovatively, especially in collaboration with external partners, managers should support social interaction with the external partner. Managers must build a trustworthy relationship with their partners and implement reciprocal information exchange. If managers open up, external partners could be a source of innovation and thus valuable partners in the internal innovation process.

While this study provides new insights into the field of innovation within interfirm partnerships, it has some limitations that must be mentioned. First, as the survey was conducted in Germany and the UK – both Western countries – generalization is impossible because different cultures may influence the results of the study. Therefore, further research should extend the generalizability by testing the model in different regions. Furthermore, the sample is dominated by a large proportion of participants in the age range of 26 to 45. While this is not surprising, it may influence the study's results, which support the hypothesis that social interaction is an important factor in the process of innovation.

Moreover, to minimize the complexity of this model, not all constructs of social cognitive theory were integrated, e.g., self-efficacy. I call upon other researchers to extend this model to provide further insights into the field of social interactions in IT interfirm networks. Other network partners, e.g., clients, should be considered in a next step. Further research should help to understand how managers could support social interaction between their employees and external partners. How could this relationship be positively influenced? What motivates employees to interact with external partners?

3.6 Conclusion

The future of businesses is becoming more and more linked to the innovation outcomes of their IT departments. Not only IT firms but also increasingly non-IT firms, like the automotive industry, must encourage the innovation and entrepreneurial capabilities of their IT departments in order to face the challenge of evolving markets. This study shows that managers should not only allow but also foster the social interaction of their employees with outsourcing partners to afford trustful relationships and thereby good information exchange. A good openness strategy is a key factor in the upcoming challenges within the innovation process.

C Practical Application

While Part B builds the core of this cumulative thesis, the following study goes a step further. It demonstrates a practical application of innovative IT outcomes that help to foster the diffusion of electric vehicles by providing mobile application services that mitigate the negative attributes of electric vehicles.

1 IT Innovation as an Enabler for Non-IT Economy

Title of Article	Disruption on the Way? The Role of Mobile Applications for Electric Vehicle Diffusion
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Published	12th International Conference on Wirtschaftsinformatik (WI 2015), Osnabrück, (Hanelt et al., 2015)
Abstract	Disruptive eco-innovations that replace existing unsustainable modes of transportation could contribute to achieve substantial improvements in environmental sustainability. Electric vehicles (EVs) have the potential to provide a more sustainable means of individual mobility, but, thus far, customer adoption remains relatively low. Following

	disruptive innovations theory developed by Christensen, the disruptive potential of EVs can be realized if their performance on traditional attributes that customer's value improves. Here, information systems can play a key role. In this paper, we use a large scale (n = 1461) empirical investigation to examine which attributes must be addressed and assess the ability of existing mobile applications (apps) to do so. Our results indicate that apps contribute to a more reliable and convenient EV-user experience. We shed light on the role of apps in connecting the vehicle, the infrastructure and the user and in creating a digital eco-system that enhances the diffusion of EVs. *Keywords: Environmental sustainability, eco-innovations, disruptive innova-tions, mobile applications*

Table 19 - Fact sheet of publication no. 4

1.1 Introduction

Climate change, global warming, and increasing greenhouse gas emissions pose great risks for human and natural systems (Mcmichael et al., 2006). Environmental sustainability is one of the key challenges for today's societies due to the severe economic and social consequences of environmental deterioration (Watson et al., 2010). Consequently, also the information systems (IS) research community has begun to think about its own contribution to achieving environmental sustainability under the theme of Green IS (e.g. Watson et al., 2010; Elliot, 2011; Vom Brocke et al., 2013; Seidel et al., 2013).

Of all the various challenges that the quest for "green" entails, the transportation domain is among the most important due to its enormous share of the world's green-house gas emissions (Nykvist and Whitmarsh, 2008). Considering that the global number of vehicles is expected to increase to 2.9 billion in 2050, the transportation sector is accountable for a significant share of the increase in emissions from all sources (Hensher, 2008; IEA, 2013). One way in which sustainability in transportation might be reached is the development and adoption of new propulsion technologies that replace conventional, unsustainable ones (Kley et al., 2011; Eisel and Schmidt, 2014). EVs have been credited as a so-called eco-

innovation, i.e., an innovation with a better environmental performance than its conventional counterparts (Govindarajan and Kopalle, 2006; Schiederig et al., 2012). Although major players in the automotive industry have introduced EVs into their product portfolio and policy makers have substantially supported their diffusion, customer acceptance has still remained at a relatively low level (Eisel and Schmidt, 2014). In order to achieve massive improvements concerning the environmental impacts of individual mobility, disruptive eco-innovations – leading to fundamental changes and replacing traditional, unsustainable modes of transportation – are needed (Carillo-Hermosialla et al., 2010; Christensen, 1997). EVs are not a new development (e.g. Jargreaves et al., 1976). Though numerous attempts to promote them have failed in the past, the ecosystem in which they are now being implemented is completely different. Today, IS are heavily integrated in everyday life, resulting in an enormous increase in information availability (Yoo, 2010). The diffusion of mobile devices, which has reached very high levels in modern societies (Pitt et al., 2011), is particularly important when it comes to mobility. These technologies digitally connect users and supply them with information anytime, anywhere. As innovations – especially eco-innovations – are directly connected with novelty, inexperience, and uncertainty, these enhanced information possibilities have the potential to drive the disruptive impact of EVs.

Following the theory of disruptive innovations developed by Christensen (1997), disruptive innovations bring along new attributes that customers value. The disruption, including the displacement of former technologies, occurs when the performance of the innovation in terms of the traditional attributes customer's value increases to a satisfying level. While technological progress of the innovation per se was described as the reason for these performance improvements in the past (Christensen, 1997), it can be assumed that the use of apps can induce this effect in the case of EVs. In this paper, we therefore address the following research question: *What is the role of mobile applications concerning the disruptive potential of EVs?*

In order to investigate this topic, we present the results of a large scale empirical investigation (n = 1461) on the perceived attributes of electric and conventional vehicles. Moreover, we present a structural analysis of existing apps (n = 81) available for EVs. In a synopsis, we then discuss how apps address the characteristics of EVs and contribute to their coverage of traditional performance attributes.

1.2 Theoretical Background

1.2.1 The Need for Disruptive Eco-Innovations

Disruptive innovations are solutions that fundamentally change the rules of the game in established sectors (Schiederig et al., 2012; Yu and Hang, 2010). They lead to substantially different market settings and technologies employed (Christensen, 1997). According to disruptive innovation theory, the attributes customers value and use to rate a specific innovation, play a major role in explaining the disruption process (Keller and Hüsig, 2009). Disruptive innovations bring a completely new set of performance attributes with them. However, in the beginning, they are rather unattractive for the mainstream market due to their disadvantages on traditional performance attributes, on which established technologies perform better. If this disadvantage can be managed and reduced over time, the disruption process occurs (Govindarajan and Kopalle, 2006).

While disruptive innovations highlight the radicalness of the change and innovation causes, eco-innovations can be described as new solutions with a lower environmental impact than their conventional counterparts (Schiederig et al., 2012). This impact can range from small improvements in the environmental performance of existing solutions to fundamental and systematic changes (Nykvist and Whitmarsh, 2008). To achieve substantial improvements of environmental quality while ensuring a comparable level of mobility, along with political and regulatory initiatives, disruptive eco-innovations that build on new, eco-friendly technological trajectories, are needed. Incremental innovations that reduce the environmental downsides of traditional technologies have only a limited ability to contribute to achieving the ambitious sustainability goals (Carillo-Hermosilla et al., 2010). For the case of individual mobility, EVs have been described as a potential disruptive eco-innovation (Schneider and Grösser, 2013). Drawing on disruptive innovation theory (Christensen, 1997), three prerequisites for EVs to achieve disruptive impacts can be derived: First, they must be able to ensure that the mobility demands of a substantial share of the population can be satisfied so that a substitution would be technically feasible. Second, they need to introduce to the market a new set of attributes that is valued by customers. Third, they must deliver a satisfying coverage of the characteristics that customers value attribute to established technologies. The fulfillment of the third prerequisite in particular can be seen as the key for achieving disruptions (Christensen, 1997). IS have recently been conceptually described as having the potential to play an

important role in this regard: “For sustainable transport, pathway technologies might include emerging information technologies for automatic vehicle control, global positioning, booking and reservations, monitoring for mobility management, and congestion charging; that is technologies associated with important behavioral and institutional changes (e.g., new user practices, standards and regulations)” (Nykvist and Whitmarsh, 2008). By doing so, they might mitigate the disadvantages of potential disruptive eco-innovations by improving their performance on traditional attributes and thus drive the disruptive change towards sustainability.

1.2.2 Mobile Applications for Environmental Sustainability

According to Gartner (2014), by 2017 apps will have been downloaded more than 268 billion times, which would make them one of the most accessible computing tools for users worldwide, resulting in personalized data streams to more than 100 applications and services every day (Forbes, 2015; Hoogsteder, 2010). Watson et al. (2002) describe this phenomenon as a form of U-Commerce, i.e., the use of ubiquitous networks for personalized and uninterrupted communications and transactions between an organization and its stakeholders that offers a value over, above, and beyond traditional commerce, where “u” stands for ubiquitous, unique, unison, and universal (Pitt et al., 2011).

Prior research has introduced the topic of environmental sustainability to the IS domain and many scholars have been dedicating their work to this research field known as Green IS (e.g., Mcmichael et al., ,2006; Watson et al., 2010; Elliot, 2011; Vom Brocke et al., 2013; Seidel et al., 2013; Chen et al., 2008; Wunderlich et al., 2013). In this context, Chen et al. (2008) argue that IS can help to develop environmental sustainability by achieving eco-efficiency, eco-equity and eco-effectiveness through automating, informing, and transforming organizations. Recent studies on apps as an integral part of Green IS has focused mainly on smart consumption, smart meter, and smart mobility (e.g., Dada et al., 2008; Froehlich et al., 2009; Weiss et al., 2012; Tulusan et al., 2012). For example, Dada et al. (2008) investigate the sustainable purchasing behavior through the use of an application during the shopping process, in which consumers can be informed about the CO2 footprint of certain products with RFID tags. This enables the consumer to change their purchasing behavior in order to support more environmentally friendly products. Furthermore, Weiss et al. (2012) examine the user acceptance of a specific smartphone application to monitor and control household energy consumption. In their findings, they explain the positive user

acceptance of such application as an element of smart meter systems. Froehlich et al. (2009) develop an application that examines the mobility behavior of users and offers them feedback on the environmental impact of their transportation choices. The application also suggests alternative means of transportation that are more environmentally sustainable. Moreover, Tulusan et al. (2012) illustrate in their study on eco-feedback technologies that apps can improve fuel efficiency even under conditions where monetary incentives are not provided. As these examples demonstrate, prior research focuses on app solutions in order to make consumption, energy and mobility more environmentally friendly.

1.2.3 Electric Vehicles and Information Systems

The introduction of EVs is seen as a vital contribution for reducing greenhouse gas emissions (e.g., Samaras and Meisterling, 2008) and achieving government climate goals (e.g. NPE, 2012). The widely used term ‘electric vehicle’ describes any vehicle powered partially or entirely by electricity (Chan and Wong, 2004; Ehsani et al., 2009). EVs have lower greenhouse gas emissions compared to conventional vehicles that are based on internal combustion engines (e.g., Samaras and Meisterling, 2008; Doucette and Mcculloch, 2011) and can even reduce these emissions by up to 50% and tailpipe emissions by up to 90% compared to conventional cars (Romm, 2006). However, the power generation mix needs to be considered in order to assess the impact on ecological sustainability in a holistic contemplation (e.g. Doucette and Mcculloch, 2011). Despite the potential emission benefits of EVs and governmental support of electric mobility projects, the expected success is still pending (e.g. Zhang et al., 2014). In 2012, EVs accounted for less than 3% of all new registrations in the European market (ICCT, 2014). The main reasons for user restraint prevailing, considered as barriers for user adoption, are the high purchasing costs, lower average range of EVs, and insufficient charging infrastructure (Hidrue et al., 2011). These barriers are briefly discussed in the following. Generally, EV customers face higher initial costs but, under certain circumstances, lower running costs compared to conventional vehicles (Brandt et al., 2012). However, the lower operational costs cannot compensate for the high initial expenses (Propfe et al., 2012). The second barrier is the EV’s limited driving range. Although most daily trips fall within today’s battery capacity, potential EV users are unwilling to accept the limited range, even when a charging possibility is available on their private property (Sonnenschein, 2010). In this context, the phenomenon of range anxiety is a common problem describing users’

concerns about not reaching a planned destination with a limited range vehicle. As charging stations are hardly profitable with the low number of existing EVs, charging station providers demand a higher market penetration prior to undertaking infrastructural measures (Schroeder and Traber, 2012). This “chicken-and-egg problem” discussed by Romm (2006) is still one of the main barriers for EV adoption.

Increasing attention to IS in the context of EVs arises from the field of energy informatics, coined by Watson et al. (2010), which includes electric mobility as integral part. In this regard, an extensive literature review by Kossahl et al. (2012) indicates that the EV’s potential has yet to be addressed by IS researchers. First efforts include, e.g., IS-supported business models in the context of EVs and EV charging. Brandt et al. (2012) present a decision support system that aids in pricing decisions in regulation energy auctions within the Vehicle-to-Grid concept by predicting maximum prices paid by the independent system operator and continues by describing the corresponding business model for the players involved. Recently, also the use of apps for EVs received attention from the IS community, as they can, e.g., provide useful information for the user. For example, Ferreira et al. (2014) present and discuss a solution that integrates several sources of data in an app. This application provides information and recommendations for drivers about range autonomy, route planning, and charging infrastructure. Moreover, Lee et al. (2011) propose an app service for EVs in order to facilitate car sharing services. Kim et al. (2014) developed a comprehensive app to help users to promptly send a rescue request. This application makes it possible for EV drivers to overcome emergency situations mainly stemming from battery depletion. Finally, Mal and Gadh (2013) present an app that enables electric vehicle smart charging. EV users are updated on the status of their vehicle and may set their charge parameters via web or native app. As these examples show, apps enable the physical mobility to be integrated into the digital landscape, changing the way cars are used and fostering new business models (Berman and Bell, 2011).

1.3 Methodological Approachs

1.3.1 Survey

Attributes constitute a critical point in the analysis in a wide variety of contexts, such as consumer choice and motivation, and form the starting point of deeper investigation (Breivik and Supphellen, 2003). Moreover, attributes are a key concept in disruptive innovation theory (Christensen, 1997). We conducted a survey using structured interviews

to retrieve both, EV-related attributes and attributes for conventional vehicles. We opted for a structured interview in terms of a quantitative approach because we had a clearly defined objective with the identification of the individuals' attributes (Myers and Newman, 2007; Di Cicco-Bloom and Crabtree, 2006). Among the established elicitation methods, we decided to use the direct elicitation technique because we aimed for the intrinsically relevant attributes of the test subjects (Breivik and Supphellen, 2003; Bech-Larson and Nielson, 1999), reflecting their personal perception of electric and conventional vehicles, without limiting their choices.

1.3.2 Data-Collection Procedure and Sample Characteristics

The survey took place from early November until the end of December, 2013. It was conducted in Lower Saxony, Germany, in public places, such as the city hall, bus stops, shopping malls, and grocery stores as a pen-and-paper, face-to-face, structured interview. This approach assured a decrease in uncertainty concerning the representation of the population by reducing the threat of excluding proportions of the population as can occur with online surveys (Duffy and Smith, 2005). Our sample comprises 1461 participants (54% females). The age of all test subjects ranges from 17 to 85 years (mean: 44 years). One-third of them (35%) hold a university degree as highest achieved education, 11% with a general qualification for university entrance, and 33% with a general certificate for secondary education. At the beginning of the interview, the test subjects were questioned about their mobility behavior and opinion about EVs, prior to the question about the attributes, in order to obtain insights about the sample. Table 20 illustrates the mean and median distance covered by the sample per week with the respective car usage. The percentage of the car use is related to the equivalent number of respondents (n) in terms of the purpose. The portion of the respondents owning a car comprises 83.7% of the total respondents, with seven of them possessing an EV.

Purpose	Use of car	Mean distance	Median distance
Work (*n* = 1146)	56%	19 km	5 km
Shopping (*n* = 1222)	66%	40 km	2 km
Picking so. up (*n* = 577)	44%	9 km	5 km
Hobby (*n* = 1013)	57%	40 km	7 km
Other (*n* = 408)	29%	61 km	10 km

Table 20 - Weekly distance traveled by the test subjects

Furthermore, we asked the test subjects how long they park their vehicle at home and at work. Table 21 shows that almost one-third of the respondents leave their car at home for half a day. According to the common eight-hour working shifts, more than 40% of the test subjects leave their cars for this time at their workplace. The test subjects showed an overall positive attitude concerning EVs as 77.4% have a generally positive opinion about EVs and more than half of them think an adoption would be reasonable for their mobility needs.

Parking time	Participants (home)	Percentage (home)	Participants (work)	Percentage (work)
0–3h	166	13.3%	373	31.6%
4–6h	404	32.5%	217	18.3%
7–9h	287	23.1%	490	41.2%
10–14h	387	31.1%	106	8.9%
Total	**1244**	**100.0%**	**1189**	**100.0%**

Table 21 - Daily vehicle parking time of the test subjects

1.3.3 Data Analysis

The attributes named by the test subjects were stored in a database, followed by an operationalization process (Babbie, 2010) of three independent researchers. In the first phase, 589 attributes for EVs and 665 attributes for conventional vehicles were collected during the interview sessions. This deviates from the total count of participants as some test subjects could not provide any attributes while others named more than one. The initial

list included redundant and similar entries, which were gradually cut down to one. The reduction of the attributes took place in two steps: (1)all verbatim attributes were reduced to one attribute and labeled with their respective number of occurrences, then (2) the attributes were assembled into variables as logical sets of attributes (Babbie, 2010). In this process, attributes with similar meanings were grouped to a variable with the precondition that the inherent attributes were exhaustive and mutually exclusive and therefore form unique variables (Babbie, 2010). In the second phase, each individual researcher proposed a list of attributes matching to a variable. The three resulting lists were compared and discussed until consensus on the final variables was reached. The conformity between the individual lists reached a high level and only minor discrepancies regarding the wording occurred, which were clarified during the discussion. These two phases resulted in a reduced list of 58 variables for EVs and 92 for conventional vehicles, forming the foundation of the analysis of the apps. The emerging variables were ordered by the count of the nomination of the attributes they contain.

1.3.4 Mobile Applications Analysis

The present research incorporates data from 81 apps in the context of EVs, particularly electric cars. The application data was collected and analyzed from the Google Play Store and the Apple App Store from May until September 2014. We chose the following English and German key words for the app search: “electric mobility”, “e-mobility”, “electromobility”, "Elektromobilität”, “Elektroauto”, “electric vehicle”, “Elektrofahrzeug”. We identified 102 apps and eliminated in the first step all apps without a description in German or English. In a second step we dropped all apps we could not access, as these are special apps from research institutes or commercial apps. The remaining 81 apps were analyzed by their description and tested on a mobile device. Based on the functionalities of these apps, we derived clusters that describe a large scale of the app characteristics. As a final step, we classified the apps based on our clusters. To get an impression of customer acceptance and the perceived quality of the apps, we included the download numbers and user ratings for each app. Table 22 shows an extract of the resulting evaluation matrix.

Nr.	App name	R	Downloads	CSt	SP	CIS	ISH	RP	DS	CS
1	Bluecub	4.4	100-500	x					x	x
2	BMW i Remote	4.4	5000-10000	x	x	x	x	x		
3	Chargelocator Global	2.1	100-500	x						
4	E.ON eMobil	5	100-500	x	x	x			x	
5	eM Analyse	3.5	100-500					x	x	
6	eMobility	5	100-500	x						
7	EV Charge Point	1	10-50	x			x			
…										
81	Zoe Quick Guide	4.1	1000-5000						x	
				50	8	11	22	11	31	4

Note: Rating – R, Charging Stations – CSt, Saving potentials – SP, Car Information System – CIS, Information Sharing – ISH, Range Prediction – RP, Decision Support – DS, Car Sharing - CS

Table 22 - App evaluation matrix (extract)

1.4 Findings

1.4.1 Attributes and Substitution Potential

In Section 1.2.1, we defined three prerequisites for EVs to have a disruptive impact. In the following, we elaborate upon them.

Prerequisite 1 – Substitution potential. The disruptive potential becomes apparent as, (1) more than 83% of the respondents use a conventional vehicle for their mobility needs, (2) the majority of the weekly trips would be manageable with an EV (Table 20), and (3) parking times would be sufficient for charging purposes (Table 21).

Prerequisite 2 – New, alternative attributes that are valued by potential customers. Table 23 displays the most prominent variables, composed of the attributes mentioned by the survey participants regarding conventional vehicles and EVs. Concerning the latter, the most prominent variables and their attributes portray EVs as eco-friendly, quiet, and modern. These aspects can be described as the new, positive performance attributes perceived by potential customers. The vast majority has a positive attitude towards EVs and consider their use for their mobility needs as reasonable.

Prerequisite 3 – Satisfying coverage of attributes customers' value for established technologies. Several negative attributes were also identified. Besides attributes such as small, unattractive, or slow, which depend on the EV model, there was a great number of

people who mentioned short driving range and high costs. The importance of negative attributes becomes apparent when relating it to the attributes the respondents named concerning conventional vehicles. Many participants perceive them as utility vehicles, which are reliable, economical, comfortable, and flexible. EV-related variables like impractical or charging effort indicate the perceived gap of EVs to come up to those traditional attributes. Attributes such as roomy, fast, beautiful, or sportive depend on the car model. Interestingly, negative attributes of conventional vehicles, i.e., harmful to the environment, noisy, or old, are related to positive aspects that respondents attributed to EVs – another hint at the disruptive potential of EVs.

Operationalized variable	Frequency	Percentage	Operationalized variable	Frequency	Percentage
eco-friendly	150	25.6%	utility vehicle	88	13.2%
quiet	76	12.9%	reliable	53	8.0%
resource efficient	42	7.2%	economical	51	7.7%
modern	41	7.0%	polluting	44	6.6%
short range	35	6.0%	comfortable	40	6.0%
small	33	5.6%	fast	39	5.9%
economical	28	4.8%	roomy	38	5.7%
expensive	23	3.9%	flexible	27	4.1%
poorly conceived	21	3.6%	expensive	22	3.3%
utility vehicle	19	3.2%	small	18	2.7%
impractical	11	1.9%	mobility	17	2.6%
charging effort	11	1.9%	noisy	16	2.4%
slow	8	1.4%	high consumption	15	2.3%
uncomfortable	8	1.4%	high performing	14	2.1%
unattractive	7	1.2%	safety	13	2.0%
flexible	6	1.0%	long range	11	1.7%

old	11	1.7%
good cost-performance ratio	9	1.4%
necessary	9	1.4%
beautiful	8	1.2%
sportive	8	1.2%

Table 23 - Attributes for electric (left table) and conventional (right table) vehicles

1.4.2 Mobile Applications

Table 24 shows the different functional clusters, their descriptions as well as the matching to the respective operationalized variables addressed in Table 23. Table 22 displays the associated user rankings and downloads. Google's Play and Apple's app store rating system are based on a 1-to-5 scale system, in which 5 stands for the most satisfactory. The average rating over all identified EVs' apps is 3.83. Over 22.2% (n = 18) of the ratings score 5 points and 9 apps have no rating. Only 4 apps are very frequently downloaded (between 10.000-50.000 downloads). Most of these apps cover the *Charging Station* cluster. The majority of the apps (n = 47) had a download rate of up to 5.000. Of these, 23 apps were not frequently downloaded (up to 100 downloads).

Cluster	Description	Matched attributes
Charging stations	Provide information about charging stations. Some allow the user to log into the charging station and pay with the app; others indicate the closest charging stations and navigate to them; some offer to choose how much energy is to be charged and/or how much it costs.	short range, charging effort
Saving potential	Provide information about the saving potentials that could be gained by using electric cars. These could be money, fuel and CO_2.	Expensive, economical, resource efficient, eco-friendly
Car Information System	Provide information about the car, such as charging status or the expected range that could be gained with this charging status. Others allow managing functionalities such as turning on the air conditioning or starting the charging process.	modern, resource efficient, charging effort short range
Information sharing	Allow the user to post information on social networks (e.g., new charging stations, free parking spaces). Suppliers for electric infrastructure use such apps to provide news to their customers.	modern, poorly conceived
Range prediction	Estimate whether the charging status of their car allows for driving to the desired destination.	short range
Decision Support	Support the user in decisions about choosing an electric car. Some apps analyze the driving habits of the potential new customer and evaluate whether the customer should buy an electric car. Other apps are more concerned with information about EV technologies and statistics.	economical, expensive, impractical, charging effort, unattractive, uncomfortable, flexible
Car Sharing	Apart from conventional car sharing functions, apps further provide information about charging status and range prediction.	resource efficient, eco-friendly, economical

Table 24 - Derived clusters and descriptions

Most of the analyzed apps (61.73%) represent the *Charging stations* cluster. These received an above average rating on their performance (3.68/5). Moreover, most of these apps were frequently downloaded (up to 5000 downloads). Further clusters addressing EVs' short range represent *Range Prediction* and *Car Information System*. Altogether, 31 applications address the *Decision Support* cluster. Many of these apps were highly rated, 6 of them were even scored with a rating of 5. Beyond that, this cluster is covered by 7 apps

with a high download rate (median 1.000-5.000 downloads). In the *Saving Potentials* cluster, only few apps (n = 8) were found. Nevertheless, one app was downloaded many times (median 10.000-50.000 downloads) and some of these apps were also highly appreciated by the customers. Only 4 apps represent the *Car-Sharing* cluster while *Information sharing* (n = 22) was among the most prominent clusters.

1.5 Synopsis and Discussion

The results of the survey indicate that, in order to increase EVs disruptive potential, their reliability, comfort and economic performance need to be improved. The findings of the systematic analysis of apps revealed that currently available solutions do already address these issues, at least partly. Considering that a substantial number of our test subjects are associating EVs to a short driving distance and to an uncomfortable charging process, the *Charging stations* cluster seems to be crucial for a broad acceptance of EVs. *Range Prediction* and *Car Information System* apps support the customers in the prediction of range, e.g., by using special algorithms for simulating an electric car drive during an operation of a conventional car. Additionally, these types of apps provide detailed information about electro mobility and hence enables customer to overcome knowledge barriers as quite a few test subjects associate EVs with poorly conceived. Other attributes resulting from the survey describe EVs as being too slow or unattractive. We believe that the Decision Support cluster may provide an appropriate basis to address these issues. This cluster supports potential users and actual drivers of EVs to gain more information about electric cars and additionally supports the decision process for users who are not sure if an electric car is suitable for them. Moreover, as shown in Table 23, most test subjects describe EVs as eco-friendly and resource efficient. This positive association is strongly underpinned by the *Saving Potentials* cluster. The related apps analyze the individual driving patterns of the user and building on this calculate specific saving potentials in terms of greenhouse gas or money. Especially the ecological saving potentials stressed by the apps may push the awareness of the correlation between green thinking and EVs. EVs also enable app-controlled features like the regulation of the charging process or the recording of physical and electrical parameters (e.g., battery status) in order to communicate them directly to the mobile phone of the user. Apart from that, we believe that the cluster of *Information Sharing* may also support the modern aspect of EVs attributed by the survey participants. We also believe that the community functions within

these apps (e.g., Facebook) may widen the knowledge of users of EVs and also enables to share their driving experiences.

Providing users with information about, e.g., the locations and availability of charging infrastructure, can be assumed to enhance the reliability of EV usage from a customer's perspective as it significantly reduces uncertainty. The same applies to apps targeting at range prediction. Apps that allow, e.g., for reservation of charging infrastructure or air-conditioning of the vehicle, increase the users convenience by automating tasks that otherwise would require manual work. Besides these applications that primarily aim to mitigate the potential disadvantages of EVs, there are apps that specifically account for the positive attributes that are newly introduced by EVs, e.g. their eco-friendliness. Here, apps, e.g., allow for calculating the environmental savings potential by using EVs. The aforementioned effects of the apps are delivered by three functions of IS that have been described in literature – automation, information and transformation (Dehning et al., 2003). This extends the aforementioned notion of Chen et al. (2008), who described these functions of IS for achieving sustainability in organizations, to the context of modern, IS supported sustainable mobility. By the three functions, apps contribute to an enhanced connection of users with the vehicle and the infrastructure, thus creating a digital eco-system that allows for a more reliable and convenient use of EVs for personal mobility. Moreover, because consumers nowadays want to benefit from the combination of digital mobile services and physical mobility infrastructures, the physical mobility system is increasingly being connected to a newly emerging digital system of interconnected mobile users (Mitchel et al., 2010). Nevertheless, as our analysis shows, especially the economic dimension of EVs still needs further improvement. Here, apps that drive cost savings or alternative business models might have a huge impact on the disruptive potential of EVs. Carsharing could pave the way for new electric car customers, as they provide the opportunity to drive an EV without the high initial costs. We found apps further drive the convenience of EV-carsharing, e.g., by using GPS and mobile booking and reservation. By doing so, apps may not only contribute to supporting new technologies but also modes of transportation within a digitally supported eco-system.

1.6 Limitations and Conclusion

The following limitations should be considered when interpreting the results. First, our study was conducted in Germany; therefore, cultural effects could not be measured. This

aspect also applies on the provincial level, since the survey was solely conducted in Lower Saxony, it is uncertain if these results also prevail in other German provinces. Furthermore, most participants had no direct experience with any form of EVs. As experience can significantly change the perception and evaluation of EVs our findings should be supplemented with studies including experienced EV drivers. Our analysis did not encompass all applications in the context of EVs as we only considered applications with German or English descriptions and had restricted access to some applications. Further research should consider the practical testing of these applications and its potential influence on the reluctance of potential customers. We therefore suggest conducting an experiment with potential customers that have prevailing restraints concerning electric mobility.

In this study, we emphasize the importance of apps for the diffusion of EVs. Through our large scale empirical investigation on the perceived attributes of electric and conventional vehicles in combination with a systematic analysis of existing apps, we could observe that mobile applications contribute with information and functionalities that help (1) reduce the perceived disadvantages of EV usage, such as low range; and (2) emphasize the perceived advantages, such as saving potentials and green thinking. This means that through the support of IS, the disruptive potential of alternative forms of sustainable mobility in general could be increased. In summary, we suggest that a complementary perspective on the development of a digital eco-system which facilitates the diffusion of alternative means of transportation is urgently needed, given the growing importance of sustainable mobility in both research and practice.

1.7 Acknowledgment

The authors would like to thank the German Federal Government for financing the research project “e-Mobility vorleben.” The results presented in this study were generated within the frame of this research project.

D Contributions

The changing role of IT from acting as a supporting unit towards being an important source of innovation in the innovation process of non-IT firms is one of the major challenges for internal IT departments. Therefore, this cumulative thesis aims to provide answers on how managers can motivate their employees to work more innovatively (Study B.1). The second and third studies (B.2 and B.3) demonstrate the importance of openness in the process of innovation. Each study provides new insights for the IS research community as well as recommendations for practitioners.

The following chapter compares the three models from Part B to evaluate which has the greatest impact on the individual entrepreneurial intention of employees in internal IT departments. Afterwards, it recapitulates the findings of each study in relation to the core research questions. The final section presents the limitations and need for further research.

1 Evaluating the Innovation Models

This chapter evaluates the influences of the models of Part B on the dependent variable: individual entrepreneurial intention. This is a common method for evaluating the predictive power of a model (Taylor and Todd, 2003; Venkatesh et al., 2003). The data for the three studies was collected via an online survey in Germany and the UK in February 2014. All of the final 354 subjects answered a questionnaire covering questions for the explanatory variables as well as the dependent variable. First, the predictive power of each model was evaluated separately based on this data. Afterwards, the models were compared with one another.

Total Sample	***n* = 354**	**Percentage**
Gender		
Male	245	69%
Female	109	31%
Age		
19–25	43	12.1%
26–35	153	43.2%
36–45	88	24.9%
46–55	50	14.1%
56–65	19	5.4%
66 and over	1	0.3%
Management		
Yes	310	88%
No	44	12%

Total Sample	***n* = 354**	**Percentage**
Working Experience		
< 2 years	20	6%
3–5 years	53	15%
6–10 years	94	27%
11–15 years	63	18%
16–20 years	46	13%
> 20 years	78	22%
Company Size		
< 50	42	12%
50–99	39	11%
100–499	86	24%
500–999	75	21%
1,000–2,499	46	13%
2,500–9,999	33	9%
> 10,000	33	9%

Table 25 - Demographics of Participants

1.1 Analysis and Results

The research model was validated using a SEM approach. Because it excels at prediction and has fitting demands for sample size, this study used the PLS method with SmartPLS version 2.0.M3 (Ringle et al., 2005). Furthermore, SPSS Statistics 21 was used for tests not supported by SmartPLS. Following Anderson and Gerbin (1988), a two-stage procedure was applied to analyze the data. The first step was to evaluate the quality of each measurement model and the data to confirm the reliability and validity of the instruments. Afterwards, each structural model was tested separately. To obtain information about the influence on individual entrepreneurial intention, a cross-model comparison based on the mean differences of the explained variance was conducted.

1.1.1 Assessment of Measurement Models

The structural model and the measurement model have a sample size (n = 354) that exceeds 10 times the number of the maximum arrowheads pointing on the latent variable (Barclay et al., 1995). To avoid cross-loadings, a confirmatory factor analysis was conducted: indicator items must load significantly more on their own construct than on any other construct. This could be confirmed for all three of the models, indicating that construct and indicator reliability is suitable. Following Gefen and Straub (2005), the reflective variables were assessed by conducting reliability and validity tests. None of the items in this study loaded on their construct lower than the cutoff of .50 and all but five items loaded on their constructs above the mentioned threshold of .707 (Chin, 1998) (see Table 26). Therefore, none of the items had to be removed.

Construct (Source)	**Items**	**Factor Loading**
Employees´ Motivation		
External PLOC (Ryan and Connell, 1989)	I contribute to the development and implementation of innovative ideas because it is financially attractive to me.	.791***
	I contribute to the development and implementation of innovative ideas because others think I should do that.	.829***
	I contribute to the development and implementation of innovative ideas so that colleagues or supervisors don't have to motivate me to do so.	.776***
	I contribute to the development and implementation of innovative ideas because it is respected within the firm.	.820***

	I contribute to the development and implementation of innovative ideas because I don't want others to get mad at or disappointed with me.	.657***
Internal PLOC (Ryan and Connell, 1989)	I contribute to the development and implementation of innovative ideas because I want to deepen my understanding of the respective subject.	.865***
	I contribute to the development and implementation of innovative ideas because I want to learn new things.	.852***
	I contribute to the development and implementation of innovative ideas because I want to find out If I'm right or wrong.	.841***
	I contribute to the development and implementation of innovative ideas because it is personally important to me to deal with new ideas.	.880***
	I contribute to the development and implementation of innovative ideas because I don't want to oppose to the development and implementation of new ideas.	.690***
Individual Entrepreneurial Intention (de Jong, 2011)	If I identify a new business opportunity, I would promote and champion my idea to co-workers and superiors.	.802***
	If I had an idea for innovations, I would try to assess its long-term opportunities and threats for the company.	.838***
	I have always wanted to implement innovations by myself.	.786***
	If I had the opportunity, I would like to develop a product or service on my own (or in a team).	.665***
	I intend to develop innovative ideas in the company's core business and implement them within the company in the future.	.789***
	I think that in the future I will develop innovative ideas in the company's core business and implement them within the company more often.	.823***
Organizational Learning		
Perceived Behavioral Control (Bamberg, 1999)	If I wanted to, I would be able to develop innovative business ideas.	.878***
	I have the necessary abilities to develop innovative business ideas.	.888***
	Developing innovative business ideas is easy to me.	.856***
IT Unit Absorptive Capacity (Pavlou and El Sawy, 2006)	Identify and acquire internal (e.g., within the department) and external (e.g., market) knowledge.	.860***
	Developing new knowledge or insights that have the potential to influence new products or services development.	.873***
	Effective routines to identify, value, and assimilate new information and knowledge.	.829***
	Transforming existing information into new knowledge.	.841***

	Exploitation of internal and external information and knowledge into our applications.	.796***
Individual Entrepreneurial Intention (de Jong, 2011)	If I identify a new business opportunity, I would promote and champion my idea to co-workers and superiors.	.803***
	If I had an idea for innovations, I would try to assess its long-term opportunities and threats for the company.	.842***
	I have always wanted to implement innovations by myself.	.779***
	If I had the opportunity, I would like to develop a product or service on my own (or in a team).	.645***
	I intend to develop innovative ideas in the company's core business and implement them within the company in the future.	.798***
	I think that in the future I will develop innovative ideas in the company's core business and implement them within the company more often.	.882***
Social Interaction		
Individual Entrepreneurial Intention (de Jong, 2011)	If I identify a new business opportunity, I would promote and champion my idea to co-workers and superiors.	.795***
	If I had an idea for innovations, I would try to assess its long-term opportunities and threats for the company.	.840***
	I have always wanted to implement innovations by myself.	.787***
	If I had the opportunity, I would like to develop a product or service on my own (or in a team).	.651***
	I intend to develop innovative ideas in the company's core business and implement them within the company in the future.	.797***
	I think that in the future I will develop innovative ideas in the company's core business and implement them within the company more often.	.831***
Information Usefulness (adapted from Lane and Lubatkin, 1998; Szulanski, 1995, 1996)	The new knowledge transferred from our IT service provider contributed a great deal to multiple projects.	.880***
	Our organization was very satisfied with the quality of the knowledge that our IT service provider provided.	.863***
	Our organization dramatically increased the perception about the efficacy of the knowledge after gaining experience with it.	.887***
	The transfer of knowledge from the IT service provider greatly helped our company in terms of actually improving our organizational capabilities	.857***

Shared Vision (Chiu, 2006)	Co-workers of the IT-service provider share the vision of helping others solve their professional problems.	.910***
	Co-workers of the IT-service provider share the same goal of learning from each other.	.903***
	Co-workers of the IT-service provider share the same value that helping others is pleasant.	.902***
Note: * p < .05; ** p < .01; *** p < .001; † removed items.		

Table 26 - Scale of Models Affecting Entrepreneurial Intention

As illustrated in Table 27, Table 28 and Table 29 the threshold for CR also scores higher than the recommended value of .707 (Gefen and Straub, 2005) and the required value above .50 for AVE could be confirmed (Bhattacherjee and Premkumar, 2004). As each questionnaire delivers the values for both the dependent and independent variables in all three models, common method variance (CMV) could be a problem (Podsakoff and MacKenzie, 2003). To check for CMV, a Harman's single factor test was conducted. The results show that common method bias is not an issue in this study. Finally the criterion of Fornell and Larcker (1981) – that the AVE for each construct is higher than the squared correlations between two constructs – was used to evaluate the discriminant validity. The discriminant validity could be confirmed for all three models. Hence, all results indicate that the measurement model is reliable and acceptable.

Construct	Range	Mean (STD)	CR	AVE	CA	IEI	EPLOC	IPLOC	JA	TV	MS	RR
IEI	1–7	5.32 (0.95)	.91	.62	.88	**.79**						
EPLOC	1–7	4.81(1.04)	.89	.61	.85	.56	**.78**					
IPLOC	1–7	5.49 (0.84)	.92	.69	.89	.76	.56	**.83**				
JA	1–7	5.48 (0.93)	.94	.83	.90	.66	.52	.70	**.91**			
TV	1–7	5.44 (0.91)	.93	.81	.88	.62	.47	.69	.78	**.90**		
MS	1–7	4.93 (0.97)	.92	.71	.90	.56	.62	.50	.59	.51	**.84**	
RR	1–7	5.31 (1.03)	.94	.88	.87	.49	.44	.50	.57	.50	.64	**.94**

Note: STD = standard deviation; CR = composite reliability; AVE = average variance extracted; CA = Cronbach's alpha; IEI = individual entrepreneurial intention; EPLOC = external PLOC; IPLOC = internal PLOC; JA = job autonomy; TV = task variety; MS = management support; RR = rewards and reinforcements; bold diagonal elements represent the square root of AVE.

Table 27 - Construct Correlations for Employee Motivation

Construct	Range	Mean (STD)	CR	AVE	CA	INB	IEI	PBC	ITAC	EXO	INE
INB	1–7	5.16 (1.24)	.93	.73	.91	**.85**					
IEI	1–7	5.33 (1.21)	.91	.62	.87	.59	**.79**				
PBC	1–7	5.27 (1.12)	.91	.77	.85	.63	.55	**.87**			
ITAC	1–7	5.43 (1.06)	.92	.71	.90	.65	.67	.72	**.84**		
EXO	1–7	5.38 (1.17)	.93	.76	.90	.60	.61	.65	.71	**.87**	
INE	1–7	5.37 (1.24)	.91	.78	.86	.52	.60	.55	.62	.62	**.88**

Note: STD = standard deviation; CR = composite reliability; AVE = average variance extracted; CA = Cronbach's alpha; INB = innovation behavior; IEI = individual entrepreneurial intention; PBC = perceived behavioral control; ITAC = IT unit absorptive capacity; EXO = external orientation; INE = information exchange; bold diagonal elements represent the square root of AVE.

Table 28 - Construct Correlations for Organizational Learning

Construct	Range	Mean (STD)	CR	AVE	CA	INB	IEI	USE	SVE	RET	NOR	SIT
INB	1–7	5.16 (1.24)	.93	.73	.91	**.92**						
IEI	1–7	5.33 (1.21)	.91	.62	.87	.59	**.85**					
USE	1–7	5.22 (1.15)	.93	.76	.89	.57	.58	**.87**				
SVE	1–7	5.27 (1.16)	.93	.82	.89	.56	.57	.77	**.88**			
RET	1–7	5.23 (1.11)	.90	.74	.83	.54	.51	.73	.74	**.86**		
NOR	1–7	5.32 (1.15)	.91	.77	.85	.55	.53	.76	.81	.79	**.88**	
SIT	1–7	5.12 (1.22)	.92	.74	.88	.60	.49	.62	.68	.68	.69	**.86**

Note: STD = standard deviation; CR = composite reliability; AVE = average variance extracted; CA = Cronbach's alpha; INB = innovation behavior; IEI = individual entrepreneurial intention; USE = information usefulness; SVE = shared vision; RET = relational trust; NOR = norm of reciprocity; SIT = social interaction ties; bold diagonal elements represent the square root of AVE.

Table 29 - Construct Correlations for Social Interaction

1.1.2 Testing and Comparing the Structural Models

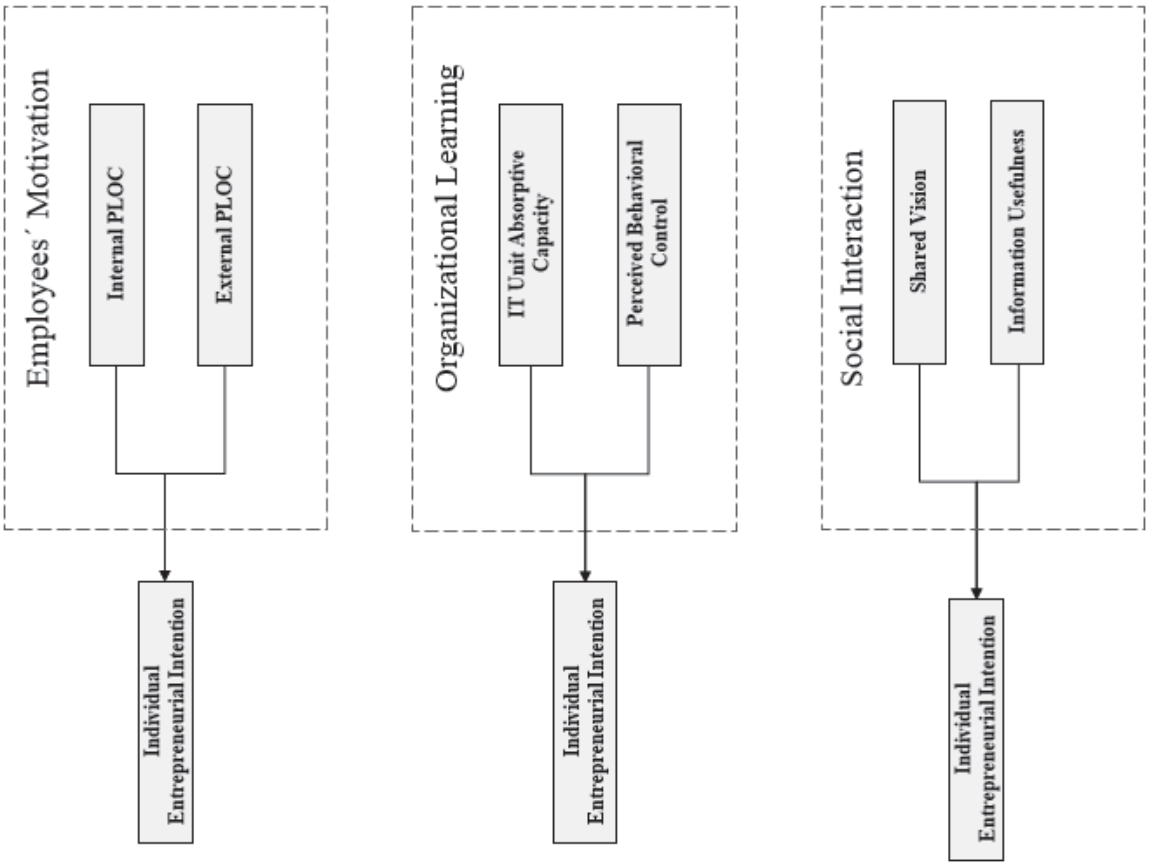

Figure 8 - Direct Effects on Individual Entrepreneurial Intention from all Three Models

This part focuses on the evaluation of the models from Part B to determine which has the greatest influence on individual entrepreneurial intention. Because the variance explained is only affected by the direct paths, just these are modeled for the three cases (see Figure 8). For sample size values higher than 100, a bootstrapping is recommended (Kock, 2011). Therefore, the bootstrapping resampling method was applied after running the PLS algorithm for estimating the structural model. The explanatory variables can explain .195 to .645 of the dependent variable. The results for each model and explanatory variable can be found in Table 30; all of the variables of the three models were significant for individual entrepreneurial intention.

	Individual Entrepreneurial Intention
Employees' Motivation	
Internal PLOC	.645***
External PLOC	.195***
Organizational Learning	
IT Unit Absorptive Capacity	.442***
Perceived Behavioral Control	.345***
Social Interaction	
Shared Vision	.293***
Information Usefulness	.360***

Note: * p < .05; ** p < .01; *** p < .001;

Table 30 - Path Coefficients of the Three Models

After estimating each model in isolation, the results were compared. Because all three models have the same number of explanatory variables, there was no need to add an adjusted R-squared. This would only be necessary if the models had different amounts, as the variance would increase with the number of explanatory variables. Therefore, this study focuses on the native R-squared for each variable to compare the different models (see Table 31).

		Individual Entrepreneurial Intention
#	**Model**	R^2
1	Employees' Motivation	.598***
2	Organizational Learning	.506***
3	Social Interaction	.377***
1_2	ANOVA results	p<.01
1_3	ANOVA results	p<.01
2_3	ANOVA results	p<.01
	Note: * p < .05; ** p < .01; *** p < .001	

Table 31 - Comparison of the Model Variances

This study used a parametric approach for multigroup analysis in PLS (Chin, 2000). Based on this approach, the three models were tested for mean differences of the R-squared value. Three steps were needed to compare the models: First, each subpopulation had to be analyzed to obtain the group-wise estimates for all model parameters. The next step was to evaluate whether there were any significant differences between the groups, based on the R-squared calculated for each model. The final step was to obtain distributions using a bootstrapping for the R-squared values (Trang et al., 2014). Following Trang et al., (2014) the one-way analysis of variance (ANOVA) was used to test whether the groups were drawn from the same population. Table 31 presents the results of the computations. The null hypothesis could be rejected for each of the three stages, based on the results of the ANOVA.

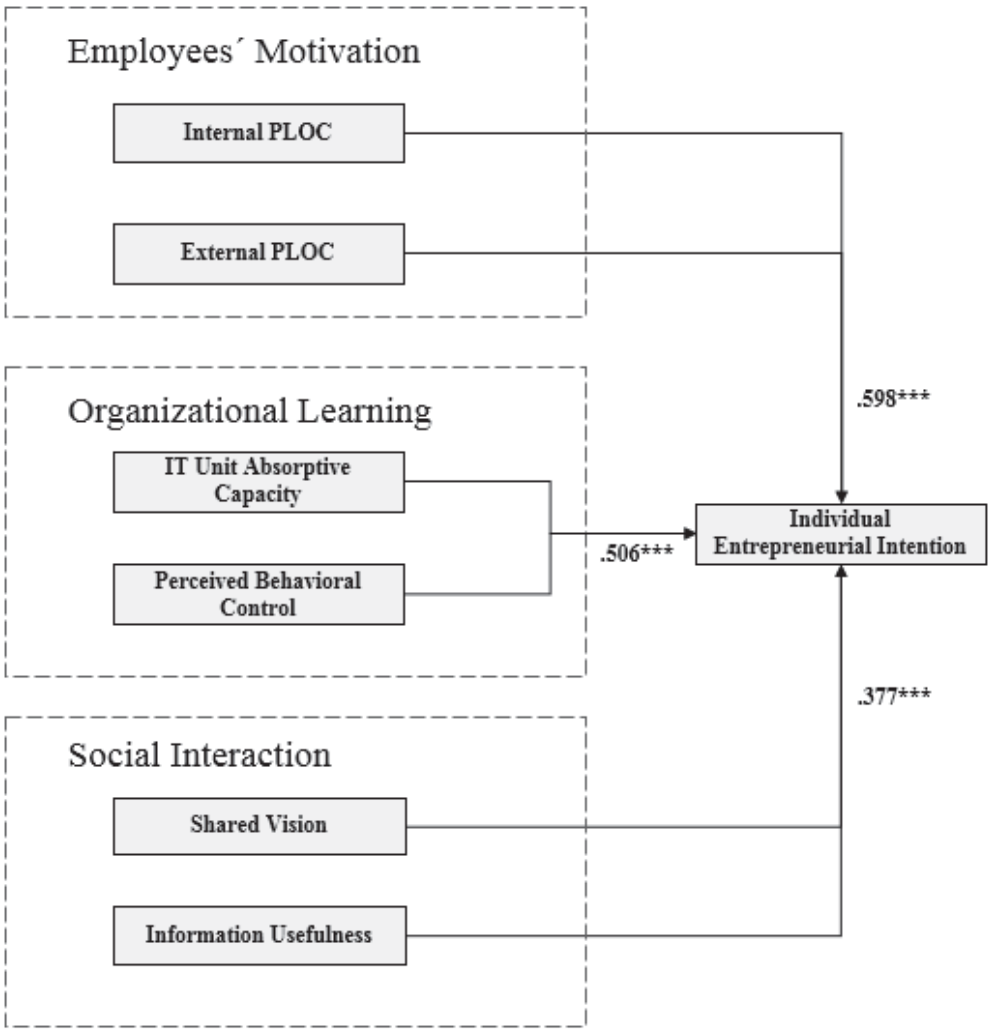

Figure 9 - Innovation Model for Individual Entrepreneurial Intention

All of the three models perform very well on individual entrepreneurial intention, with each model having a significance level of $p < 0.01$. The model for employee motivation has the highest explanation rate with .598 percent of variance, followed by the model for organizational learning with .506 percent. This means that both factors – the motivation of each employee as well as the ability to gain knowledge in the firm's context – are very important in the process of individual innovation. The model for social interaction also performs well; it explains .377 percent of individual entrepreneurial intention.

2 Findings and Implications

Besides its contribution to IS research, this study has a major focus on contributing to practice. Therefore, this chapter examines the findings for the IS research community and then draws implications for managers of in-house IT departments. As these findings and implications are based on the studies from Parts B, C, and D, the wording is adopted from these sections.

2.1 Contribution to the IS Research Community

Following the sense of Wade and Hulland (2004), this cumulative thesis strives to empirically validate refined as well as established theories. The partial least square method (Ringle et al., 2012) was applied to quantitatively evaluate these theories.

The literature reviews in each study of Parts B and C highlight the lack of research on how IT can face the challenge of its role changing from acting as a functional part of the business towards being a major contributor to the firm's innovation process (e.g., Guillemette and Paré, 2012; Nambisan et al., 2014; Sambamurthy et al., 2003; Westermann et al., 2014). This cumulative thesis contributes to this field of research by offering insights into the four research questions from Section A.2 as follows.

RQ1: *Can extrinsic motivation influence IT employees' endogenous motivation towards a more entrepreneurial intention?*

The empirical evaluation of the model from Section B.1 indicates that endogenous motivation has a high influence on individual entrepreneurial intention. It shows that if extrinsic motivation is internalized (internal PLOC), employees are more motivated to interact innovatively. This is supported by the job design constraints of task variety and job autonomy, which best support innovative action. The corporate environment, management support, as well as rewards and reinforcements have no significant influence on the employees' behavior towards innovation activities.

Although the internal PLOC has the greatest influence, there is a weaker but still significant influence of the external PLOC. Like with the internal PLOC, job constraints have a positive influence on the external PLOC. For the corporate environment, only management support has a positive effect on motivation. Surprisingly, there is no influence of rewards and reinforcements on the external PLOC.

Answer Q1: Extrinsic motivation has a significant influence on an IT employee´s endogenous motivation towards entrepreneurial intention. It should be combined with factors for the corporate environment as well as job design constraints.

RQ2: *What is the influence of openness and absorptive capacity on IT entrepreneurship?*

The evaluation of the model from Section B.2 reveals the significant positive influence of openness on the IT unit's absorptive capacity. In this context, openness refers to the interaction and reciprocal information exchange with external knowledge sources, such as IT outsourcing partners. Hence, based on a rich data set with 354 answered questionnaires, this study was able to empirically validate prior research (e.g. Lane et al., 2006).

This study also sheds light on the ambiguous role of open innovation in the IT department's internal innovation process (e.g., Laursen and Salter, 2006). It indicates that the in generally positive impact of open innovation on the innovation outcome found (e.g., Davey et al., 2010) is also found for the innovation process within firm's IT department. This is in line with Chesbrough (2003), who demonstrates that the innovation process of a department with a high absorptive capacity profits from the external knowledge accessed due to openness.

The negative effect of external orientation on internal innovativeness (West and Bogers, 2014) could not be validated for the context of IT departments. In this study, the external orientation relating to external knowledge and information helps departments to innovate if the level of absorptive capacity is high. This could be explained by the nature of innovative activities as creative processes (Lane et al., 2006; Sambamurthy et al., 2003), where bidirectional learning from external sources helps to transform and adapt external knowledge to the firm's context and thus helps to innovate.

Answer Q2: Openness and absorptive capacity have a substantial influence on IT entrepreneurship by fostering the entrepreneurial intention of each individual.

RQ3: *Are social interactions between internal IT employees and the outsourcing partners important in the process of internal innovation?*

Studies on openness and absorptive capacity have already shown that external knowledge and information are positively related to the innovation outcome of a company. The

specific focus of RQ3 on the interaction with external partners indicates that a higher degree of social interaction can be an important factor in the innovation process. The IT department experiences a greater stimulation of trust due to closer ties (Gulati, 1995) between outsourcing partners and the internal IT. The study also supports the hypothesis that these closer connections help to gain a common understanding of goals and expectations. Both factors are found to be important for knowledge and information sharing (Gulati, 1995; Ring and Van der Ven, 1994). This could also be confirmed for IT employees. Moreover, the study reveals that reciprocity is an important factor in this context for improving the quality of information. Therefore, one can state that in combination with the results from RQ2, social interactions have a major contribution to the innovation activities of the in-house IT. The exchange of knowledge and information is flanked by shared goals resulting from the close cooperation, which also has a statistically positive influence on the entrepreneurial intention of each employee.

Answer Q3: Close social interactions lead to a trustful social interaction with outsourcing partners. They help to raise the quality of knowledge transfer and in focusing on shared goals. As this leads to a greater entrepreneurial intention of the internal IT employees, one can state that appropriate social interactions can play an important role.

***RQ4**: What is the role of mobile applications concerning the disruptive potential of EVs?*

The results from Section C.1 reveal that negative attributes of EVs often relate to the battery technology and the problems for the driver that come along with it. While a major concern is range anxiety (Eisel and Schmidt, 2014) and the charging process, the study's findings point out that IS already offers solutions addressing this topic. Range prediction and car information systems provided by apps – in this case on a smartphone – support customers in evaluating the use of their car for the planned tour, thereby addressing the problem of range anxiety. It helps them locate the nearest charging infrastructure and easily reserve a spot for charging. Decision support systems help users to evaluate whether their current driving behavior is suitable for the change from a traditional car to an eco-friendly EV, thus helping to increase the number of EVs on the road. Besides these apps that attempt to mitigate the potential disadvantages of EVs, there are also apps that account

for positive attributes, such as eco-friendliness, by providing information about greenhouse gas savings; this can help encourage customers to buy EVs.

Answer Q4: By mitigating potential disadvantages, mobile applications play an important role in contributing to the wider dissemination of EVs. Apps can help analyze driving behavior, thus allaying concerns about the switch to an electric vehicle.

2.2 Contribution to Practice

Besides the contribution to the IS research stream, there are also some implications for practitioners. Managers today are facing increasing global competition requiring constant innovation. In the scope of this cumulative thesis, which focuses on the individual level of entrepreneurism, the role of middle managers plays a crucial role for their employees because they are in direct contact with them. Thus, middle managers and their teams are the origin of innovations. To prepare these managers for future challenges, this chapter summarized the findings that are especially important for middle managers.

The results indicate that employees experience a greater individual intention to be innovative if it becomes personally meaningful. While prior research in IS and CE has treated motivation as a trigger, via either extrinsic or intrinsic motivation, SDT claims that motivation is endogenous – individuals initiate all behaviors (Ryan and Deci 2000; Skinner 1953). As a sub-theory of SDT, OIT conceptualizes individually experienced levels of autonomy as existing along a continuum of motivation, referred to as the perceived locus of causality. The PLOC explains that the degree ranges from external to internal regulations, depending on the level to which the individual experiences behavior as initiated and endorsed by him- or herself. For managers, it is important that employees perceive a high degree of autonomy over their choices and actions, as this stimulates entrepreneurial activities. Under the influence of internal PLOC, individuals feel congruent with their psychological needs (Sheldon, 2002). In contrast, when feelings of pressure and coercion from external sources are linked to their behavior, individuals perceive themselves as being controlled. The study from Section B.1 demonstrates that the feeling of autonomy fosters the creativity of employees and their engagement for entrepreneurial activities. Therefore, managers concerned with exploration tasks should champion innovative activities in addition to providing organizational and financial resources. A lack of management support leads to a higher risk awareness, reducing motivation towards

entrepreneurial actions because employees fear being victimized if their endeavors fail (Manimala et al., 2005). Thus, if management support creates a climate of valuing entrepreneurial thinking and action, employees would be more encouraged in this area. Providing autonomy, as Google demonstrates impressively, leads to a greater motivation towards innovation activities. Besides allowing employees a free choice of time, e.g., to gather new knowledge and experiment with new ideas (Loock et al., 2013), goals must be both realistic and complex to increase the goal achievement of individuals (Locke and Latham, 2002; 2006). Another step for managers is to offer a high degree of task variety and more complex tasks to reduce workplace monotony, which lowers the entrepreneurial intention of each employee. This comes along with the reduction of routine and exploitative tasks and increase of exposure to other domains. If managers want to stimulate the entrepreneurial intention of employees, they must adjust both the corporate environment as well as job constraints. In addition to these internal measures, managers should open up their innovation channels, thereby opening up their departments. Opening up the innovation channels and gathering knowledge from external sources means going through four phases: In the first phase, firms must search and acquire external knowledge, whereas the second phase involves integrating external knowledge into the company. The third and fourth phases run parallel. While in the third phase firms commercialize the external knowledge, the fourth phase deals with the interaction with corresponding partners, e.g., co-creation or reciprocal information exchange. As the studies in Sections B.2 and B.3 reveal, the department's absorptive capacity – the firm's ability to assimilate new information and knowledge – is important in adapting knowledge to the firm's specific context. However, it is not only important to open up to external partners and gather information; one must gather the right information and use it for internal innovation. Bidirectional learning can be a means to overcome this problem. It not only increases the knowledge stock but also helps to build the capacity to transform external knowledge for a firm's own commercial purposes.

If this process of knowledge gathering works properly for the department, strong social interaction ties are created, helping to gain new knowledge and use external partners as a source of innovation. The findings of this thesis reveal that this external knowledge and openness fosters internal innovation. A difficulty in this process is that to use these advantages, managers must overcome the dilemma of opening up while external partners are also competitors.

3 Concluding Remarks and Further Research

While this thesis understands itself as a first step into the field of corporate entrepreneurship and innovation in a changing situation for internal IT departments, some limitations should be considered when interpreting the results.

The studies from Part B are based on a sample of questionnaires filled out by IT employees in non-IT firms in Germany and the UK. Following Lee and Person (2000), regional and cultural factors could have an impact on the entrepreneurial orientation of an employee. Therefore, while interpreting the results of these studies, one must be aware that they represent Western European employees and may differ from other regions. The data for Part C have the same limitation on a provincial level, as the data was collected via face-to-face interviews in Lower Saxony. Therefore, it is unclear whether the results are representative for other provinces in Germany or other parts of the world. To generalize the results for Parts B and C, researchers should repeat the investigation in a larger study that considers the different regions of the world, thus helping to eliminate regional and cultural influences.

Furthermore, these studies were based on answers given in a time frame of only four weeks in February 2014 for Part B and about eight weeks from November to December 2013 for Part C. While these rich samples provide solid data for the analysis as a starting point to explore the factors influencing individual entrepreneurial intention, future research should use longitudinal data to verify the results. Beside these geographic and time frame–specific influences, the sample from the studies of Part B have a large proportion of respondents in the age range of 26-45. Although this may reduce the generalizability of the study in terms of how the factors mentioned influence the individual entrepreneurial intention of other age groups, it still represents the typical ages of those working in an IT department (Bureau of Labor Statistics, 2013; Fraunhofer, 2012). Hence, this sample can be seen as representative for studies on IT departments.

Besides the need for further research to eliminate the limitations mentioned above, additional research is needed to gain a deeper understanding of how to foster the entrepreneurial behavior of IT department employees and thus support the change towards being an innovative part of the business. While this study provides insights on how to increase intention towards innovation, it neglects the issue of how to turn it into

entrepreneurial action. Aside from these factors influencing the innovation and entrepreneurial intention of employees, the way ahead requires some deeper understanding. Especially for practitioners, it is important to understand how individual entrepreneurial intention can be turned into corporate entrepreneurial action. As intention is just the first step, firms must take the next step to be competitive on the market. This study reveals that the motivation of employees has a major effect on entrepreneurial intention (see D.1.1.2) Therefore, further research should extend the model from Section B.1 by finding moderating effects on individual entrepreneurial intention as well as the internal and external PLOCs. While this study helps to understand the impact of direct effects, understanding moderating effects will help to complete the picture. Furthermore, this study encourages researchers to evaluate whether employees who deem themselves to be not innovative can be motivated to work innovatively via the right leadership style.

As the studies from Sections B.2 and B.3 demonstrate, interaction with external sources can lead to more innovation (Dahlander and Gann, 2010; Laursen and Salter, 2006). The concept of open innovation (Chesbrough, 2003) highlights the important role of external sources for the innovation process. Like the above-mentioned studies that use IT outsourcing partners as the external influence on the entrepreneurial intention of each member of the IT department, further research should investigate the role of, e.g., customers or suppliers on this process. To support a deeper understanding of the knowledge, this cumulative thesis focuses on direct effects while neglecting the moderating effects of this important part of innovation. Further research should therefore address this omission, focusing on the moderating effects on the ability of employees and firms to gather knowledge.

While the positive influence of task variety on motivation – internal PLOC – was demonstrated in Section B.1, the role of cross-functional integration mechanisms requires further investigation (Jansen et al., 2005). Researchers should address this important gap to help practitioners support their employees in this part of innovation.

The study in Section B.2 statistically supports the findings of Faems et al. (2010), finding that absorptive capacity is an important factor in combination with external knowledge sources and has a positive impact on the internal innovativeness of a department. This finding is in disagreement with the results of West and Bogers (2014), who state that absorptive capacity has a negative influence on internal innovation behavior. However,

further research should focus on the organizational and individual factors that help to bridge the gap between external and internal innovation.

Besides the need for further investigations regarding the individual employee within the innovation process of a company, the research stream of IT-enabled innovation lacks research in other areas. Can digital transformation and consumerization have a positive influence on the innovation capacity of an IT department? New concepts are necessary to help IT departments apply the new impulses from different external sources and practitioners need guidelines on how to combine these new concepts with their own IT strategies to avoid being bypassed by other departments in the innovation process. Furthermore, best practices that involve in-house IT instead of just letting them be deliverers of technologies are needed. Moreover, the influence of the positioning of the IT department should be examined. As it is likely that innovations are fostered when the CIO reports directly to the CEO, the CIO can provide new drivers for the business strategy, thus functioning as an important component for the innovation strategy. Part B highlights the important role of external sources for knowledge. Researchers should explore the role of new communication streams, such as social media or online communities. As communication is always difficult, it will be important for collaborations to choose the right way to communicate. Existing communities could be used to explore new ideas and knowledge if IT departments are able to explore these communication streams.

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Appendix

Appendix A. Overview of the authors' contribution in the studies included in this thesis

No	Section	Title	Author	Authors' contribution
#1	B1	It's not for the money, it's the motives: The mediating role of endogenous motivations on IT employees´ entrepreneurial behavior	Henning Kruep	45%
			Johann Kranz	45%
			Lutz M. Kolbe	10%
#2	B2	Feed the machine – an empirical investigation of the impact of openness in innovation on IT entrepreneurship	Andre Hanelt	50%
			Henning Kruep	50%
#3	B3	Start social – IT outsourcing as a key factor for IT innovations	Henning Kruep	100%
#4	C1	Disruption on the Way? The Role of Mobile Applications for Electric Vehicle Diffusion	Andre Hanelt	30%
			Ilja Nastjuk	15%
			Henning Kruep	10%
			Matthias Eisel	10%
			Carolin Ebermann	10%
			Benjamin Brauer	10%
			Everlin Piccinini	6%
			Bjoern Hildebrandt	6%
			Lutz M. Kolbe	3%

Appendix B. Overview of author's published and forthcoming double blind reviewed articles as of January 2016

Authors	Publication	Ranking
Hanelt, A., Nastjuk, I., Kruep, H., Eisel, M., Ebermann, C., Brauer, B., Piccinini, E., Hildebrandt, B., Kolbe, L. M.	Disruption on the Way? The Role of Mobile Applications for Electric Vehicle Diffusion, 12th International Conference on Wirtschaftsinformatik (WI 2015), Osnabrueck Germany, 2015 (accepted for publication)	C
Hanelt, A and Kruep, H	Feed the machine – an empirical investigation of the impact of openness in innovation on IT entrepreneurship, in: European Conference on Information Systems (ECIS) 2015, Muenster, Germany, 2015 (accepted for publication)	B
Opitz, N., Kruep, H., Kolbe, L. M.	Green Business Process Management – A Definition and Research Framework, Proceedings of the Hawaii International Conference on System Sciences (HICSS) 2014, Big Island, Hawaii 2014 (accepted for publication)	C
Opitz. N., Kruep H., Kolbe L. M.	How to Govern your Green IT? – Validating a Contingency Theory based Governance Model, Proceedings of the 18th Pacific Asia Conference on Information Systems (PACIS), Chengdu, China, 2014 (accepted for publication)	C
Kruep, H., Kranz, J., Kolbe, L. M.	It's not for the money; it's the motives? The mediating role of endogenous motivations on IT employees' entrepreneurial behavior, in International Conference on Information Systems (ICIS) 2014, Auckland, New Zealand 2014 (accepted for publication)	A
Kruep, H.	Start social – IT outsourcing as a key factor for IT innovations, in: Multikonferenz der Wirtschaftsinformatik (MKWI) 2016, Ilmenau, Germany 2016 (accepted for publication)	D
Kruep, H., Hanelt, A., Kolbe, L. M.	Sustainable IS Research In Developed Countries – A Chance For Sub-Saharan Africa?, in: European Conference on Information Systems (ECIS) 2013, Utrecht, Netherlands, 2013 (accepted as research in progress)	B

The study ranking was assessed according to VHB Jourqual 3

Curriculum Vitae

PERSONAL INFORMATION

Henning Kruep

Date of Birth: 21.05.1986

Place of Birth: Nordhorn

Nationality: German

ACADEMIC CAREER

2012 - 2014	Research member at Sustainable Mobility Research Group (SMRG), Universität Göttingen, Germany
2009 - 2012	M. Sc. in Business and Computer Science, University of Braunschweig, Germany
2006 - 2009	B. Sc. in Business and Computer Science, HS Osnabrueck, Germany
2005 - 2006	B. Sc. in Information System, HS Emden, Germany
2004	School Diploma, Technisches Gymnasium Nordhorn, Germany

RELEVANT WORKING EXPERIENCE

Since 2013	CIO, LIST AG
Since 2012	Research associate at the Chair for Information Management
2012	Master thesis, cooperation with Bonifatius Hospital Lingen, Germany
2010	Working student, PLRI Braunschweig, Germany
2009	Bachelor thesis, cooperation with Bonifatius Hospital Lingen, Germany
Since 2006	CEO, Cyrex-IT

Versicherung gemäß §16 Pruefungs- und Studienordnung fuer den Promotionsstudiengang Wirtschaftswissenschaften

1. Die Gelegenheit zum vorliegenden Promotionsvorhaben ist mir nicht kommerziell vermittelt worden. Insbesondere habe ich keine Organisation eingeschaltet, die gegen Entgelt Betreuerinnen und Betreuer fuer die Anfertigung von Dissertationen sucht oder die mir obliegenden Pflichten hinsichtlich der Pruefungsleistungen fuer mich ganz oder teilweise erledigt.

2. Ich versichere, dass ich die eingereichte Dissertation „IT Corporate Entrepreneurship – identifying factors for IT innovations in Non-IT companies“ selbstständig und ohne unerlaubte Hilfsmittel verfasst habe; fremde Hilfe habe ich dazu weder unentgeltlich noch entgeltlich entgegengenommen und werde dies auch zukuenftig so halten. Anderer als der von mir angegebenen Hilfsmittel und Schriften habe ich mich nicht bedient. Alle wörtlich oder sinngemäß den Schriften anderer Autoren entnommenen Stellen habe ich kenntlich gemacht.

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