Bus Inf Syst Eng 57(6):363–375 (2015)
DOI 10.1007/s12599-015-0387-z

RESEARCH PAPER

Innovation Through BYOD?

The Influence of IT Consumerization on Individual IT Innovation Behavior

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Received: 10 October 2013 / Accepted: 25 March 2015 / Published online: 27 May 2015

Abstract Leveraging the IT innovation capabilities of employees is becoming increasingly feasible in the era of IT consumerization. Consumer IT tools, in form of tablets, smartphones, or social media, are entering organizations and are changing the way employees use technology for work. In this article, the authors decipher the term IT consumerization in more detail by providing a framework that illustrates the various perspectives of the phenomenon. They then apply the various perspectives in order to propose an IT consumerization framework that juxtaposes consumer IT with enterprise IT in its ability to lead to individual IT innovation behaviors. Using data from 486 European employees that work for large-sized companies, they are able to infer that consumer IT and the permission to use privately owned IT exert positive effects on employees' innovation behaviors. An examination of the various perspectives supports the assumption of science and practice that BYOD strategies and the diffusion of consumer IT within organizations are beneficial for innovation. The results provide a first step in theorizing about the innovative power of IT consumerization.

Keywords IT consumerization · BYOD · CYOD · Individual innovation · Employee-driven innovation · Smartphones · Tablets

Accepted after two revisions by Prof. Dr. Leidner.

Electronic supplementary material The online version of this article (doi:10.1007/s12599-015-0387-z) contains supplementary material, which is available to authorized users.

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1 Introduction

Innovation capabilities are vital for any organization facing competition. With the emerging trend towards IT consumerization, a phenomenon where employees are using consumer tools in the workplace, the notion of individual IT innovation behavior is increasingly becoming real. Enabled by the falling costs of hardware and the increased functionality of mobile technologies that provide access to an ever-growing catalogue of applications, individuals have started to operate individual information systems (IS) whose complexity are comparable to that of enterprise systems (Baskerville 2011). The increased level of IT competence within the workforce (Davis 2013), paired with a widening availability of tech tools, causes organizations to rely more heavily on individual innovation than in the past. In other words, organizations may ask their employees "to use digital technology to innovate on their own behalf" (Gates 2012).

Several researchers have already observed a fundamental change in the direction of how innovation flows (Moschella et al. 2004; Moore 2011). The innovation process of the twentieth century was a top-down process, in which a new technology was first deployed in organizations and only afterwards diffused into the consumer realm. The laptop is a classic example in this regard. Utilized in organizations at first, it gradually transpired into the private sphere and is now used in many households. The opposite can be noted for the last few years. IT tools forced their way from the consumer market into the corporate environment (Moore 2011; Weiß and Leimeister 2012). Smartphones and tablets are entering organizations and are used in addition to, and sometime in lieu of, existing enterprise IT. Sometimes employees are even willing to pay for those tools on their own (Unisys 2010). To work efficiently and with more fun, employees have also created a so-called "consumerization catch-22" (D'Arcy 2011), forcing IT departments to provide consumer-grade tools and applications instead of enterprise-specific ones that are often perceived as slow and cumbersome. As a consequence, many organizations have started offering "bring-your-own-device" (BYOD) strategies or handing out consumer IT to their employees (Schadler 2013). In doing so, they implicitly acknowledge the fact that the flow of innovation is now a bottom-up rather than a top-down process and requires a fundamental rethinking of IT strategy.

Extant research has already recognized that the innovative potential driven by the utilization of consumer IT is one of the major benefits of IT consumerization. In a worldwide study, 61 % of executives considered an increase in organizational innovation behavior as one of the most important objectives in supporting the diffusion of consumer IT in their respective organizations (Harris et al. 2012). Likewise, conceptual studies were able to draw an anecdotal link between IT consumerization and innovation by stating that IT empowered individuals are more likely to create a positive change in their work behaviors and should be viewed as an important driver that facilitates a culture of innovation within the organization (Dell and Intel 2011; Junglas et al. 2014). In this sense, it is argued that organizations must activate the innovation behavior of every individual, following the paradigm of "innovation is everyone's job" (Andriole 2012).

Research acknowledges that behaviors which may have been viewed as inappropriate or even deviant before are becoming increasingly desirable for organizations when competing in turbulent environments (Spreitzer and Sonenshein 2004). The existence of "shadow IT" is witness to this fact. Built within the organization and without approval, shadow IT is a testament to individual innovation that can take place inside organizational walls (Behrens 2009). While employees without sufficient tech skills can only submit to, or entirely dismiss, organizational IS (Askenäs and Westelius 2000), tech-savvy employees have the potential to (re-)create work behaviors by means of shadow IT, leading to higher productivity and control (Zimmermann and Rentrop 2014).

The fact that innovative uses of IS coexists with routine uses has already been shown for the post adoption stage of an IS implementation (Li et al. 2013). IT consumerization underscores this innovative use since employees have a say in what tool is applied to their job needs. They have the choice of using enterprise provisioned IT that may come in different shapes and forms, including desktops or smartphones (Junglas and Harris 2013). They also have the choice to not use enterprise provisioned IT and to purchase their own devices instead (Ortbach et al. 2013). Between enterprise and consumer IT, employees can leverage the vast amount of IT available in the market to solve particular work tasks – no matter whether the rest of the organization, including the management, is still struggling with the adoption of such IT tools, both technically and culturally (Axtell et al. 2000; May 2012).

Organizations are therefore interested in better understanding the influence of IT consumerization on employee-led innovation. More specifically, they want to better understand how IT consumerization can lead to individual IT innovation and how to evaluate this benefit against potential setbacks and risks. While the practitioner literature has hinted at the relationship between IT consumerization and innovation, none of the studies differentiates between the various perspectives or details the effects of specific consumer IT tools. IS research has investigated determinants of IT innovation in the context of post adoption behavior, suggesting that the work environment influences the degree to which users create additional value with technology (Ahuja and Thatcher 2005; Jasperson et al. 2005; Li et al. 2013). However, it does not take into account two essential characteristics of the IT consumerization trend: (1) the increased IT competence among individuals, potentially leading to innovation (Kettinger and Lee 2002), and (2) the possibility for individuals to freely choose between different IT tools, originating from within as well as from outside the organization (Ortbach et al. 2013). In addition, extant literature still lacks a proper quantification of innovation outcomes at an individual level in general (Hammond et al. 2011) and in the context of IT consumerization in particular (Harris et al. 2012; Gartner 2013).

Hence, our paper focuses on the following research question: *In which ways does IT consumerization influence individual IT innovation behavior at work?* In order to address this question, we draw on individual innovation theory. We will propose three models, based on three IT consumerization perspectives, namely market, individual,

and organization. Our quantitative evaluation of the models aims to inform future theory with respect to IT consumerization and individual IT innovation. The study is explorative in nature, i.e., we aim to test a range of potential effects as proposed in the practitioner literature.

The remainder of the article is structured as follows. We first delve into the notion of individual IT innovation behavior. We then decipher the term IT consumerization in more detail by providing a framework that illustrates the various perspectives of the phenomenon. After that, we develop our research hypotheses along the perspectives of IT consumerization, followed by a discussion on how and to what extent IT consumerization contributes to individual innovation. We then develop three distinct research models for each perspective that are tested using survey data from 486 European employees. After discussing the implications for science and practice, we further suggest potential follow-up research topics.

2 Individual IT Innovation Behavior

A widely accepted definition of *individual workplace innovation* comprises an individual's "intentional introduction and application…of ideas, products or procedures, new to the relevant unit of adoption, designed to significantly benefit…the individual, organization or wider society" (West and Farr 1990, p. 9). In the context of IT, employees can use their individual IS to experiment with different applications, and choose among them, or even create entirely new processes that open up new ways to perform work tasks (Baskerville 2011). Thus, for the purpose of this study, we will adopt West and Farr's definition to the IS context and define *individual IT innovation* behavior as the intentional introduction and application of information technology (both hard- and software), new to the organization, designed to significantly benefit the individual, the organization, or the wider society.

A plethora of research exists that describes how individual innovation takes place in the workplace, accounting for the unstructured and sometimes chaotic nature of the innovation process (Kanter 1988). Individuals that behave innovatively undertake a set of activities across multiple stages (Scott and Bruce 1994; Axtell et al. 2000). Most typically, the set of stages comprises phases of (1) idea generation, (2) its contextual application and assessment, as well as (3) its deployment (Janssen 2000; Patterson 2002). Some studies combine the latter two phases under the umbrella term implementation (Anderson et al. 2004; Hammond et al. 2011). However, distinguishing between these three stages is important in order to understand the difference between individual creativity and innovation. While creativity is primarily associated with idea generation, innovation can be seen as broader process that includes the generation of possible alternatives; it also entails that an alternative is eventually implemented and put into action (Anderson et al. 2004).

Particularly in cases of technological innovation, researchers have noted a tension between idea generation and implementation (Anderson et al. 2004), i.e., good ideas are not implemented due to a lack of implementation know how. IT consumerization may help to overcome this dilemma because employees outside the IS department are increasingly aware of the possibilities that technology is able to provide. Therefore, they may be more quickly to realize potential enhancements, i.e., they might implement a selected alternative into the work setting more swiftly (Amabile 1996; Hammond et al. 2011). In this respect, current developments are reminiscent of the early 1980s (Baskerville 2011), when graduates entering the workplace started the era of end-user computing and caused considerable productivity gains for organizations (Benson 1983). This era has been deemed the first iteration of an employee-led IT innovation within organizations – IT consumerization, on the other hand, is destined to be the second (Harris et al. 2012).

3 Perspectives on IT Consumerization

IT consumerization has been debated extensively in the practitioner literature using varying definitions (Niehaves et al. 2012). In an effort to structure the amorphous nature of the term, literature has suggested to take three distinct perspectives: an individual, organizational and market perspective (Harris et al. 2012). All three perspectives represent different facets of IT consumerization (Table 1), however, they are also overlapping and influence one another (Köffer et al. 2014b).

Taking a *market perspective*, IT consumerization describes that tools, originally developed for the consumer marketplace, gradually find their way into organizations (Harris et al. 2012). Thus, the origin or intended target market of the IT tool is at the center of this perspective. Public clouds, social media, and smart mobile devices are just a few examples that have their roots in consumer offerings and are increasingly adopted by enterprises (Prete et al. 2011). As a result, a distinction between consumer and enterprise IT is ever more impossible.

Taking an *individual perspective,* IT consumerization describes that individuals transfer their IT experiences from their private realm into the workplace (Moschella et al. 2004; Harris et al. 2012). Owning a wide variety of IT tools as part of their personal life, employees are prone to expect the same functionality and ease of use from tools provisioned by the enterprise (D'Arcy 2011). Thus, the

Table 1 IT consumerization and its various perspectives

Perspective	Focus	Exemplary definitions of IT consumerization
Market	Origin or intended target market of the IT tool	"[IT consumerization is] the adoption of consumer applications, tools and devices in the workplace – [it] can enhance innovation, productivity and employee satisfaction." (Harris et al. 2012, p. 99)
		"The trend that IT innovations that originate in the consumer market, are infiltrating enterprises is called consumerization of IT" (Weiß and Leimeister 2012, p. 3)
Individual	Ownership of the IT tool	"Consumerization of information technology refers to privately owned IT resources, such as devices or software that are 'co-used' for business purposes." (Niehaves et al. 2012, p. 1)
		"Consumerization of IT, that is, the recent trend where user-owned consumer oriented hard- and software spreads in business environments." (ENISA 2012, p. 1)
Organizational	Permission to use private IT tools for work	"IT consumerization is the plethora of devices and applications used within the corporate firewall that may not be part of a company-sanctioned list and/or have not been formally approved and that may be seen as either a threat or an opportunity." (Harris et al. 2012, p. 101)
		"Consumerization of IT is […] deeper and much farther-reaching than simply allowing employees to bring their own personally-purchased PCs and devices to work." (Gens et al. 2011, p. 1)

ownership of the IT tool is at the core of this perspective. It defines IT consumerization as bringing private IT to the enterprise and using it for business purposes.

From an *organizational perspective*, IT consumerization captures that organizations have either formally approved the use of privately owned IT in the workplace (for example, in form of a BYOD program), reject its use, or found alternatives along the spectrum of both extremes (Harris et al. 2012). Thus, the permission to use private IT within the organizational boundaries takes center stage in this perspective. Many organizations hesitate to permit privately owned IT into their corporation because of data security reasons. After all, there is an increased chance that private and corporate data may get intermingled on privately owned devices, and/or that accessing privately held software accounts on cloud services may lead to data storage outside organizational jurisdiction (ENISA 2012). Also, if appropriate tools are not provided, employees are likely to disregard organizational rules and bypass corporate IT by carrying their privately owned IT tools into the workplace (Harris et al. 2012).

4 IT Consumerization Perspectives and Innovative Behavior

We will develop our set of research models based on the various perspectives described in the previous section. To investigate the particular impact of IT consumerization on individual IT innovation behavior, we will formulate our hypotheses by comparing both the difference between consumer and traditional IT tools as well as the difference between privately owned and company-provided IT tools.

4.1 Market Perspective

Appreciating the functionality that consumer IT tools can provide while preventing their unauthorized use, an increasing number of companies have started to equip their employees with the most recent consumer tools available in the market. Sometimes they even let employees choose their preferred IT tool from a list of devices, following a choose-your-own-device (CYOD) or "company-owned, personally-enabled" (COPE) IT strategy (Köffer et al. 2014a).

Traditional tools, as opposed to consumer tools, originate in the enterprise market and were not developed with the consumer market in mind. For the purpose of this study, we consider desktop and laptop computers as traditional tools, since we argue that they have been widely used within organizations – long before the term IT consumerization was first mentioned by Moschella et al. (2004). The use of these traditional tools constitutes the prevailing practice that has been applied by organizations since the end-user computing era in the early 1980s (Rockart and Flannery 1983).

Drawing on the principle of "learning by doing", individuals are said to acquire more and more routinized skills and to become more familiar with IT during the post acceptance stage (Saga and Zmud 1994). Since usage alone is likely to positively influence innovative behavior (Li et al. 2013), we argue that the use of consumer IT strengthens the impact on innovative behavior. For the purpose of this study, the set of consumer tools examined comprises smartphones, netbooks, and tablets. Particularly smartphones and tablet computers have the ability to be equipped with hundreds of applications that can support a wide

variety of work tasks. The plethora of available applications, paired with ubiquitous Internet access, is one of the key features that contribute to an employee's productivity (Karlson et al. 2009). Individuals may use their smartphone, for example, to perform work tasks in situations where working would simply be impossible without (Yun et al. 2012; Köffer et al. 2014b). Not surprisingly, consumer IT is often described as "much simpler, more reliable, and more functional" than corporate IT (Moschella et al. 2004) – a notion that resembles the concept of relative advantage in IS innovation research. A new technology has a relative advantage if it provides a higher perceived usefulness when compared to its previously used counterpart (Agarwal and Prasad 1998).

In addition, form factors have often been cited as a differentiating criterion in the market. Especially the ease of use, or the effort individuals have to put into using a technology, is a characteristic that has been attributed to consumer IT, particularly to netbooks, tablets and smartphones (Harris et al. 2012; Ortbach et al. 2013). Effects of ease of use are further strengthened by the level of self-efficacy an individual exhibits towards technology (e.g., Venkatesh 2000). Since theoretical work on post adoption behaviors has determined ease of use as predictor of individual IT innovation behavior (Kettinger and Lee 2002; Carter et al. 2012; Li et al. 2013), we expect that an individual's ability to innovate will increase with increased consumer IT usage. We therefore propose:

> $H_{1:}$ The use of *consumer IT* (tablets, netbooks, and smartphones) will have a higher impact on individual IT innovation behavior than the use of *traditional IT* (desktop and laptop computers).

4.2 Individual Perspective

Employees have a choice. They may use privately owned or company provided IT for work purposes. If IT tools are privately owned, the organization typically has no say in selecting or purchasing them. Instead, employees have opted to buy these tools and to use them for work purposes on their own. Organizations are left with granting privately owned tools proper access to corporate systems and/or permitting remote logins.

Apart from providing access to corporate information whenever and wherever needed, the use of privately owned desktop computers, for example, is comparable to an employee's teleworking behavior at home. Teleworking has been widely discussed in academic and practitioner outlets for many years (Bailey and Kurland 2002) and is nowadays viewed as a related theme of the IT consumerization trend (Schalow et al. 2013). This is not surprising as consumer IT has made it increasingly more feasible to work from outside the company and to integrate work and life spaces (Yun et al. 2012).

Using privately owned tools similar to the ones provided by the organization for work has several benefits – for employees and organizations alike. Technological knowledge that employees acquire through ownership of IT tools in their private lives can be reused for professional purposes. Organizations are therefore less prompted to push their employees to keep up with technological advances. Instead, their employees come already trained by these systems (Moschella et al. 2004). In fact, it has been found that 64 % of employees "learn about…technologies in their personal life and bring them into the office" (Prete et al. 2011, p. 7). In addition, related theories in the area of individual workplace innovation have emphasized the role of task-specific expertise. In a componential model of creativity by Amabile (1996), expertise, or "the foundation of all creative work" (p. 5), describes an individual's technical proficiency in a target domain. Numerous studies have shown that expertise impacts individual-level innovation (e.g., Patterson 2002; Taggar 2002). In IS research, task-specific expertise has been conceptualized as technology cognizance, representing a "user's knowledge about capabilities of a technology, its features, potential use, as well as costs and benefits" (Nambisan et al. 1999, p. 372). Accordingly, the frequent use of technology in the private realm is likely to transpire into task-specific expertise and technology cognizance concerning work tasks (Harris et al. 2012). Simultaneously, it will also lead to an increase in self-efficacy, or an individual's belief about his or her "capabilities to organize and execute the required actions" with the help of IT tools (Bandura 1997, p. 3). The level of self-efficacy required to perform business tasks has also been shown to positively influence innovation behavior (Axtell et al. 2000; Hammond et al. 2011). Furthermore, employees typically exhibit higher levels of care and responsibility for their privately owned technologies when compared to company provisioned IT (Köffer et al. 2014b). Studies have shown that employees who exhibit high levels of responsibility are also more likely to promote workplace changes (Morrison and Phelps 1999). Based on the above, we stipulate:

> H_2: The use of *privately owned* IT will have a higher impact on individual IT innovation behavior than the use of *company-provided* IT.

4.3 Organizational Perspective

An organization that permits the use of privately owned IT for work purposes provides employees with the freedom of IT choice. Employees have been found to value, and even enjoy, this freedom. They appreciate fewer rules and a

leading role in device procurement and adoption (Kettinger and Lee 2002; Dell and Intel 2011). As it seems reasonable that open policies will influence the extent to which privately owned IT is used for work purposes, we hypothesize their effect for two scenarios in which employees own their respective IT tools:

H_{3a}: The permission to use *privately owned* IT within the organization will positively influence the use of *privately owned traditional* IT (desktop and notebook computer) for work.
H_{3b}: The permission to use *privately owned* IT within the organization will positively influence the use of *privately owned consumer IT* (tablets, netbooks and smartphones) for work.

As the frequent use of privately owned technologies is assumed to be associated with innovative behaviors (Harris et al. 2012), and in line with the reasoning provided in Sect. 4.2, we also hypothesize an effect of privately owned IT on individual IT innovation behavior. This effect will likely occur for both traditional as well as consumer IT. We therefore state:

H_{4a}: The use of *privately owned traditional IT* within the organization will positively influence individual IT innovation behavior
H_{4b}: The use of *privately owned consumer IT* within the organization will positively influence individual IT innovation behavior.

In addition, we also argue that the level of permission to use privately owned IT tools within the workplace will also exert a direct effect on individual IT innovation behavior. If individuals are allowed to choose their tools at work, they select them for idiosyncratic reasons, for example because of relative advantage or social influence (Baskerville 2011; Ortbach et al. 2013). It further underscores that the possibility of making a choice among technologies is one of the distinguishing factors that constitute IT consumerization (Junglas and Harris 2013). Expanding an individual's level of freedom will also foster an employee's job autonomy. An increase in job autonomy, in turn, has been associated with a heightened innovation behavior (Axtell et al. 2000; Krause 2004) and BYOD strategies (Hopkins et al. 2013). Autonomy has also been found to positively influence an individual's potential of trying to innovate with IT (Ahuja and Thatcher 2005; Carter et al. 2012).

Apart from an individual's freedom of choice, the permission to use privately owned IT tools may also be viewed as an indicator of a positive, open and supportive work environment. Hammond et al. (2011) summarize this latter aspect under the term positive climate, which has a favorable impact on individual innovation. We therefore propose:

H_5: The permission to use *privately owned* IT within the organization will have a direct positive influence on individual IT innovation behavior.

4.4 Research Models

To investigate our hypotheses, we derive three distinct research models, each of which corresponds to one of the three perspectives of IT consumerization as introduced in the previous section. Figure 1 depicts our research models and the corresponding hypotheses.

5 Research Method

5.1 Data Collection

Our data was collected as part of a global research project on IT consumerization, which was intended to study the phenomenon in detail. For the purpose of this article, we concentrated on the data collected from European employees. The employee sample was drawn from organizations with at least 100 employees; it was equally distributed across industry and age groups. It included only those employees who worked with at least one of the technologies sampled as part of their daily routine.

All questions were mandatory to avoid missing values. Respondents were asked whether they owned a particular device or whether their company provided it. In order to increase the validity of the results and to be able to compare path coefficients, we only included those respondents that reported access to all technologies considered in the study, i.e., we focused on those individuals that had the opportunity to use desktops, laptops, smartphones, and tablets – irrespective of their ownership. Due this qualifying criterion, our initial dataset was reduced from 1556 to 486 responses ($n = 486$) for model 1 and 2 because many respondents were not provided with smartphones or tablets by their organization. Table 2 shows the demographic details.

5.2 Measurement Items

Several studies have measured individual innovation behavior as a generic (and non-IT related) construct. One of the first measurements was proposed by Scott and Bruce (1994), who captured innovative behavior on a reflective six-item scale that asked for the development and implementation of new ideas. Their measurement was adopted

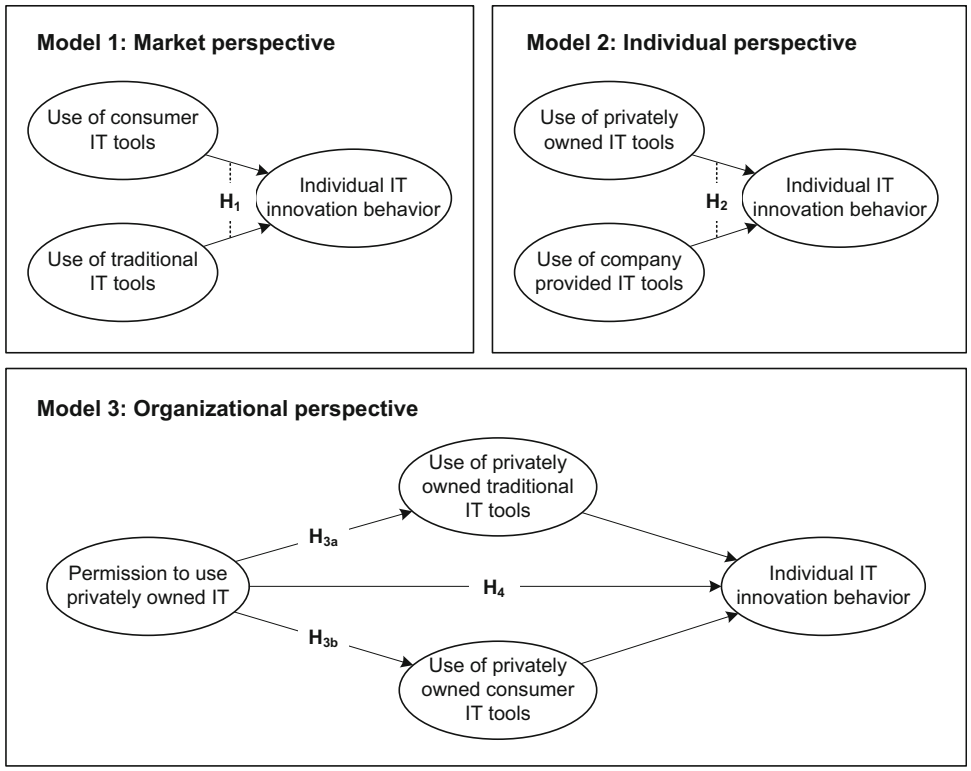

Fig. 1 Research models

Table 2 Demographic details of the sample

Age	10.7 % (18–24), 25.5 % (25–34), 24.7 % (35–44), 23.9 % (45–54), 15.2 % (55–65)
Gender	34.6 % (female), 65.4 % (male)
Country	27.2 % (Italy), 20.0 % (Spain), 15.6 % (Scandinavia), 15.6 % (France), 11.9 % (United Kingdom), 9.7 % (Germany)
Industries	11.8 % (products), 10.1 % (public sector), 9.3 % (financial services), 9.3 % (professional services), 8.8 % (communications and high tech), 8.6 % healthcare and life science, 7.0 % (retail), 35.2 % (other)
Role	59.7 % (individual contributor), 40.3 % (managers)
Tenure (company)	17.1 % (≤2 years), 40.5 % (3–10 years), 42.4 % (≥10 years)

by later studies of Janssen (2000) and George and Zhou (2001).

To derive a measurement for individual IT innovation behavior, we adopted three items from the above mentioned studies that resemble the stages of individual innovation, such as search process (IB3), promotion to others (IB4), and problem solving (IB5). All items were framed for the context of IT. Furthermore, we developed two items in order to capture typical IT consumerization behaviors that were identified in the literature, such as the search for non-work related applications (Ortbach et al. 2013) and downloading applications to solve work problems (Prete et al. 2011). The formulation of these items followed the principles for improved scale item development by Podsakoff et al. (2003), meaning that the addition of supplemental items allowed the decomposition of questions into simpler and more focused behaviors with respect to IT consumerization. The complete list of items can be found in the ESM appendix. In that sense, our conceptualization of individual IT innovation behavior is similar to the concept of "trying to innovate with IT" by Ahuja and Thatcher (2005). It is also associated with the goal of finding new uses of existing workplace IT. For an overview of other related constructs, please refer to Ahuja and Thatcher (2005).

To accommodate the different IT consumerization perspectives, we used multiple-item, formative measurement scales. The corresponding items were built using a two-step approach. First, we identified the most common traditional and consumer IT tools used for work purposes from the literature. We selected desktop and laptop computers for the former and smartphones and tablets for the latter, since

those devices are most commonly used in organizations (Prete et al. 2011). Second, we generated items measuring the extent of IT usage. More specifically, we measured the usage of traditional and consumer tools for work tasks that were either privately owned or company provisioned. This resulted in four distinct use scenarios: (1) use of company provided traditional IT tools (CT), (2) use of privately owned traditional IT tools (PT), (3) use of company provided consumer IT tools (CC), and (4) use of privately owned consumer IT tools (PC).

We chose the lean conceptualization of use (Burton-Jones and Straub 2006), because we wanted to explore the effects on individual IT innovation behavior at a generic level, rather than focusing on a particular task or IT tool function. Both traditional and consumer IT can be used for a wide range of work tasks, making it hard to use richer measures like the number of features used, or the extent to which the tool is used to carry out a specific task. The lean conceptualization allowed us to explore possible influencing factors in more detail – which was our primary objective since only little IS research has targeted the phenomenon at all. Consequently, the extent of use was measured for each tool using a five point Likert scale, ranging from never to daily. Furthermore, it was measured by offering respondents the possibility to multi-select among tools they used for their work. For each tool used, the extent of usage was measured independently, thus fulfilling the criteria for formative measurements as suggested by Jarvis et al. (2003). As our indicators are not interchangeable, dropping one would alter the nature of the construct. We also argue that our selection of potential IT tools is comprehensive as it captures all IT tools that are primarily used in organizations (Rossiter 2002).

In order to measure permission levels, we used a two-item measurement with dichotomous scales that captured whether or not the organization permitted the use of privately owned IT tools (hardware and software) for work. We used reflective indicators instead of formative since we argue that the permission for hardware and software is not completely independent. For instance, if an organization allows the use of personal hardware devices for work, using private software that runs on these devices is often (implicitly) permitted as well. Furthermore, we only included respondents for model 3 who reported that the use of privately owned IT was officially allowed (9.9 % for software, 11.5 % for hardware) or explicitly denied by the enterprise (38.7 % for software, 33.5 % for hardware). We deliberately dropped all responses where respondents stated that the organization (a) permitted only the use of some tools, (b) simply tolerated privately owned IT tools, or (c) had no policy in place that regulated the usage of privately owned IT tools. As a result, model 3 contained 173 usable responses.

5.3 Hypotheses Testing

To evaluate each of our research models, we applied partial least squares structural equation modeling (PLS-SEM), using SmartPLS 2.0 (M3) software (Ringle et al. 2005). To test hypotheses H_1 and H_2, i.e., to compare the differential effects between consumer and traditional IT tools as well as those of privately owned and company provided IT tools on individual IT innovation behavior, we employed the path comparison method proposed by Cohen et al. (2003). As SmartPLS only computes standardized path coefficients, we calculated the unstandardized coefficients using SPSS multiple regression analysis. We used one-tailed tests as the differential effects were hypothesized to be directional. This procedure is in line with recent IS research (e.g., Li et al. 2013).

6 Results

We first assessed the quality of the outer measurement models. All reflective constructs were evaluated regarding indicator reliability and convergent validity by checking on their item loadings. All item loadings were higher than 0.8, which is considered to be acceptable (Hair et al. 2013). The respective values are shown in Table 3.

To assess the validity of our formative constructs, we first checked for multicollinearity. More specifically, we calculated the variance inflation factors (VIF) for each. All VIF values in all models were below 5.0, indicating that multicollinearity carries no effect (Hair et al. 2011). Furthermore, we calculated the outer loadings and weights, as well as the significance level for all items. Consistent with the recommendations by Hair et al. (2013), we tested the corresponding outer loading and outer loading significance for all indicators with no significant outer weights. As the outer loadings were either higher than 0.5 or significant, we found empirical support to retain all indicators. Values for VIF, outer weights, and loadings are reported in ESM Appendix B.

To evaluate the indicator reliability, we used the internal consistency reliability (ICR) measure. For individual IT innovation behavior and permission to use privately owned IT tools, this measure was higher than the suggested threshold of 0.7 for all three models (Bagozzi and Yi 1988). To assess convergent validity, we analyzed the average variance extracted (AVE). The corresponding values for our reflective measurements were above 0.5, indicating that the construct is able to explain more than half of the variance of its indicators (Bagozzi and Yi 1988). In order to assess discriminant validity, we compared the square root of the AVE with the correlations from other latent constructs. As all correlations were lower, discriminant

Table 3 Outer model evaluation: reflective measurements

Reflective construct	Item	Outer loadings		
		Model 1	Model 2	Model 3
Individual IT innovation behavior (IB)	IB1	0.854	0.854	0.863
	IB2	0.891	0.891	0.884
	IB3	0.914	0.914	0.916
	IB4	0.847	0.847	0.866
	IB5	0.880	0.880	0.864
Permission to use privately owned IT tools (PERM)	PERM1	–	–	0.978
	PERM2	–	–	0.981

Table 4 Reliability and validity testing of model 1 (market perspective)

Construct	ICR	Mean	SD	IB
IB	0.943	2.783	1.085	0.877[a]
CC/PC[b]	Formative	2.174	1.300	0.694
CT/PT[c]	Formative	3.063	1.253	0.673

[a] Square root value of AVE for IB

[b] Company provided consumer IT (CC) and privately owned consumer IT (PC)

[c] Company provided traditional IT (CT) and privately owned traditional IT (PT)

Table 5 Reliability and validity testing of model 2 (individual perspective)

Construct	ICR	Mean	SD	IB
IB	0.943	2.783	1.085	0.877[a]
CT/CC[b]	formative	2.690	1.125	0.687
PT/PC[c]	formative	2.314	1.259	0.840

[a] Square root value of AVE for IB

[b] Company provided traditional IT (CT) and company provided consumer IT (CC)

[c] Privately owned traditional IT (PT) and privately owned consumer IT (PC)

validity can be assumed (Fornell and Larcker 1981). The individual test results for each model are shown in Tables 4, 5 and 6.

After validating the adequateness of the measurement models, we tested our hypotheses using the structural models. The variance explained (R^2) for our dependent variable individual innovation behavior accounted for 52.3 % in model 1 and 2, and for 50.3 % in model 3, which has been classified as moderate effects (Chin 1998). Considering our research context and the manifold determinants of individual IT innovation not included in the model, we rate this value to be acceptable. Moreover, when compared with results drawn from studies with similar endogenous variables (Ahuja and Thatcher 2005; Yuan and Woodman 2010; Li et al. 2013), the variance explained for individual IT innovation behavior appears considerably larger.

We used bootstrapping to evaluate the significance of our path coefficients. Figure 2 and Table 7 show the path coefficients and corresponding t-values for the relationships between our latent constructs. As assumed, the use of IT tools – irrespective of the use scenario – generally had a positive effect on individual IT innovation behavior. One exception is the use of privately owned traditional tools in model 3.

Table 6 Reliability and validity testing of model 3 (organizational perspective)

Construct	ICR	Mean	SD	IB	PERM
IB	0.944	2.421	1.150	0.773[a]	–
PERM	0.980	0.173	0.371	0.586	0.979[a]
PT[b]	Formative	2.353	1.494	0.512	0.487
PC[c]	Formative	1.627	1.213	0.654	0.562

[a] Square root values of AVE for IB and PERM

[b] Privately owned traditional IT (PT)

[c] Privately owned consumer IT (PC)

To test hypotheses H_1 and H_2, we adopted a path comparison method, as suggested by Cohen et al. (2003). Table 7 depicts the results. For model 1, we found a significant difference between the path coefficients. Thus, H_1 was supported, i.e., the impact on individual IT innovation behavior was significantly higher for employees that use consumer IT than for those that use traditional IT tools. For model 2, the difference between the path coefficients, representing the effects of personally owned tools versus company provided tools on individual IT innovation behavior, was not significant. Thus, H_2 was rejected.

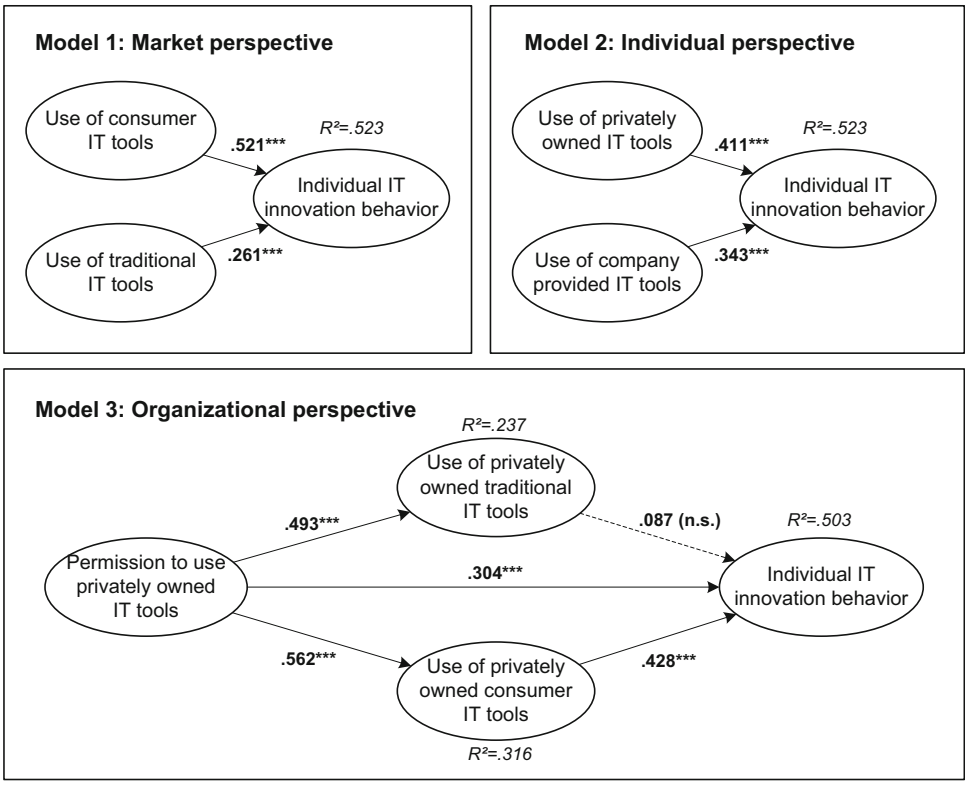

Fig. 2 Structural models with path coefficients. ***p < 0.001, **p < 0.01, *p < 0.05, *n.s.* not significant

Table 7 Path comparison method results

Research model and path comparison	Path coefficients (from PLS)	Unstandardized path coefficients	Results
Model 1: CC/PC vs. CT/PT	0.521*** vs. 0.261***	0.201 vs. 0.110	1.832*
Model 2: CT/CC vs. PT/PC	0.411*** vs. 0.343***	0.233 vs. 0.198	$0.735^{(n.s)}$

n.s. not significant (one-tailed tests)

*** p < 0.001, ** p < 0.01, * p < 0.05

For model 3, where organizations either prohibit or permit privately owned tools for work purposes, our analysis confirmed a direct positive relationship between permission level and individual IT innovation behavior ($\beta = 0.300$, $t = 4.432$), thus supporting H_5. The mere fact that people were allowed to use privately owned IT tools for work purposes had an immediate effect on individual IT innovation behavior.

Furthermore, the use of privately owned traditional IT ($\beta = 0.487$, $t = 7.801$) as well as the use of privately owned consumer IT ($\beta = 0.562$, $t = 6.581$) increases if an organization explicitly permits its use, supporting H_{3a} and H_{3b}. However, while the effect of privately owned IT on individual IT innovation behavior was found to be significant for consumer IT (H_{4b}), it turned out to be insignificant for traditional tools (H_{4a}).

Overall, the results show that besides a direct effect between permission to use privately owned IT (H_5), there is an indirect effect ($ß = 0.424$, $t = 5.390$) over use of privately owned consumer IT. We calculated the Variance Accounted For (VAF) to determine whether the construct of privately owned consumer IT acts as full or partial mediator (Shrout and Bolger 2002). The VAF value was 0.44, indicating a partial mediation in the relation between the permission levels and individual IT innovation behavior (Hair et al. 2013).

7 Discussion

In this study, we aim to quantify the relationship between IT consumerization and individual IT innovation behavior. Our results show that both the type of tool in form of consumer and traditional IT (market perspective), and the permission to use privately owned IT (organizational perspective) influence individual IT innovation behavior. IT

ownership, on the other hand (individual perspective), was not identified as an important factor. Here, both the use of privately owned and company provided IT tools had a positive effect on individual IT innovation behavior. The slight difference between both factors was found to be insignificant. Moreover, when comparing organizations that allow the use of privately owned IT with those who do not, only those employees who used consumer tools (as opposed to traditional tools) show a positive impact on individual IT innovation behavior. In addition, we found that the permission to use privately owned IT directly impacts individual IT innovation behavior, i.e., there is a measurable and significant effect that goes beyond what is mediated by the actual use of technology.

7.1 Implications for Practice

Our results have several implications for practitioners. First, the market perspective suggests that the introduction of consumer IT into the enterprise is beneficial and contributes to an employee's innovative behavior within the organization. This effect may be related to the improved functionality of consumer IT combined with the enhanced knowledge about these functionalities that individuals have gathered in the private realm (Köffer et al. 2014b). Second, our findings with respect to the individual perspective suggest that for innovative behavior to occur it is irrelevant who owns the tool. The effect is the same whether organizations choose to provide employees with IT tools or provide employees the option to choose their own. An explanation for the missing effect is that an individual's knowledge about the functionality of privately owned and company owned consumer IT is likely to be similar. Third, the implementation of a BYOD strategy – irrespective of employees utilizing this option or not – may yield additional benefits with regards to individual IT innovation. This indicates that the mere perception of freedom regarding IT choice can affect an individual's IT innovation behavior. This effect may be attributable to an increased empowerment or autonomy an employee perceives, and is likely to increase if organizations actively pursue a culture that welcomes experimental IT usage (Hammond et al. 2011; Junglas et al. 2014).

Our study contributes to the ongoing debate on whether IT consumerization exerts positive or negative effects for an organization. Many organizations still struggle to include consumer IT into their organizational IT portfolio (Gens et al. 2011). Given the increasingly diverse IT landscape (D'Arcy 2011), organizations may soon have no choice but to exploit individual innovation more than in the past. IT executives and policymakers may draw on our research to evaluate the effects of such strategies within their organization.

Since the development of IT tools is subject to constant changes, organizations are forced to re-evaluate their current IT infrastructure frequently. Knowledge workers are currently facing an avalanche of information stored in various forms and formats that were non-existent 5 years ago (Moore 2011). Transferred to the context of IT consumerization, this means that strategies will most likely fail where the monitoring of market developments is an exclusive task for the management. Instead, it seems advisable, and is consistent with our results, to follow the market closely with the entire workforce and thereby use consumer IT tools as "a resource of creativity and innovation leading to order and stability" for organizations (Behrens 2009).

Chances are that organizations will utilize the increased IT ability of the workforce to shift innovation responsibilities from the IT department to individuals (Köffer et al. 2014b). By doing so, organizations will be required to pay closer attention to the quality of IS use, rather than time and frequency of IS use (Li et al. 2013). IT leaders should think about putting procedures in place where employees are granted permission to foster innovation. For instance, traditional organizational tasks like IT choice and selection may be "outsourced" to employees. A recent survey by Gartner (2013) already found that 38 % of organizations plan to stop providing IT devices to workers by 2016.

7.2 Implications for Research

With respect to theory, our research contributes to extant knowledge in three major ways. First, we are among the first to provide a quantification of the three perspectives on IT consumerization, as developed by Harris et al. (2012), by showing that taking both a market and organizational perspective is particularly relevant for individual IT innovation behavior. Future research on IT consumerization may build upon these initial findings and explore the effects in more detail by integrating other IS theories.

Second, we show that permission to use privately owned IT for work has a direct effect on individual IT innovation behavior. Future theory building efforts in the context of IT consumerization will have to take this into account, for example, by testing intermediate constructs, such as autonomy or self-efficacy, to further explore this effect.

Third, we provide a new measurement instrument for individual IT innovation behavior which is anchored in the literature and can be used by other researchers, for example, to assess the effects of organizational strategies, targeted to improve innovation at the individual level. Further research may also take into account pro-innovation biases, i.e., the fact that innovative behavior is, by default, seen as positive, and investigate the potential drawbacks of individual IT innovation behaviors (Yuan and Woodman 2010; Li et al. 2013).

8 Limitations and Outlook

As every study, our research has several limitations. First, we have focused on the individual as our unit of analysis. Therefore, our results should be extrapolated with care to the context of groups or organizations – not least because literature abundantly cites personality traits as determinants of individual innovation (Anderson et al. 2004). Further quantitative research is necessary that can provide additional insights into the relationship between IT consumerization and individual IT innovation behavior. For instance, IT consumerization has been associated with gains in employee satisfaction (Harris et al. 2012) and motivation (Niehaves et al. 2012), both of which have been considered as factors influencing individual innovation behavior (Anderson et al. 2004).

Second, our study focused exclusively on hardware. It should be noted that IT consumerization also comprises the use of consumer software in the workplace (Gens et al. 2011; Harris et al. 2012). However, since devices serve as vehicles that allow access to various applications, we believe that analyzing the use of devices is a first step in deciphering their influence on individual IT innovation behavior.

Third, although we study the general permission of an organization to use privately owned IT tools, our study does not scrutinize scenarios of shadow IT. Analyzing under which circumstances employees will value their own aspirations higher than that of organizational guidelines, and thus violate existing policies, is a promising topic for future research on positive deviance and individual innovation.

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