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ORIGINAL ARTICLE

Conceptualizing the Integration of Business and Private Components in Individual Information Systems

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Abstract Individuals build their individual information system (IIS) with which they manage the boundary between different domains of life. In this age of permanent mobile accessibility, however, the boundary between the private and business domains can become blurred. While some users try to maintain a degree of separation between the two IIS sub-systems (the private and the business information system), others integrate them. Understanding such integration is essential as it affects well-being and performance in both domains. To further this understanding, we introduce a conceptualization of IIS that distinguishes between four layers of IIS: devices, digital identities, relationships, and information. To measure IIS integration, we develop a method based on the IIS components' usage frequencies in each domain. We evaluate our conceptualization as well as our measurement method by empirically testing a theoretical model of IIS integration on multiple layers. Our data provides empirical support for the importance of relationship integration as one of the four

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layers. This leads us to the conclusion that even though IIS are composed of four layers, only the relationship layer is of interest regarding IIS integration. Our results are of interest and service to individuals, organizations, and IT designers who aim to manage IIS integration for individual and organizational benefits.

Keywords Individual information systems · Boundary theory · IIS integration · Structural equation modeling

1 Introduction

Since Apple released the iPhone in 2007, smartphone use has increased rapidly. By 2016, the share of adults who owned a smartphone had reached 60% in Germany and an even higher 72% in the United States (Poushter 2016). Ever since, this tech affinity has spread to a wide range of digital technologies, such as computers, tablets, and smartwatches. Owing to the variety and potential of mobile devices, there has also been a remarkable increase in social networking sites, media streaming, online shopping, and other online services (vor dem Esche and Hennig-Thurau 2014). While this has afforded users greater mobility, it has also led to more work outside offices (Global Workplace Analytics 2016), which people tend to perform not only on business but also on private devices (Harris et al. 2012). Efforts to contain the spread of the SARS-CoV-2 virus and COVID-19 involved unprecedented numbers of employees working from home with an assortment of devices, their digital identities and the like stemming from both the private and the business domains of their lives. The consequences of this continuing digitalization stand to reason: the private and business domains are increasingly overlapping.

People build their own individual information system (IIS), which leads to more or less overlap between the private and business domains. Baskerville (2011a, p. 1) defines IIS as "an activity system in which individual persons, according to idiosyncratic needs and preferences, perform processes and activities using information, technology, and other resources to produce informational products and/or services for use by themselves or others." An IIS has two sub-systems that either serve the user as a business person or as a private person (Baskerville 2011b). We call these sub-systems the "business information system" (BIS) and the "private information system" (PIS). It is worth noting that BIS and enterprise information systems (EIS) differ in the sense that a BIS is the system of an individual in the business domain, while an EIS refers to an entire organization. To manage the increasing overlap of their private and business lives, individuals either use their IIS to separate the two domains as far as possible by keeping their PIS and BIS apart, or they integrate the systems into the opposite spaces of life to blend their private and business domains. In boundary theory (Ashforth et al. 2000), this strategy is called a boundary management tactic (Nippert-Eng 1996).

High integration of the sub-systems, and of the two domains of life they serve, has been associated with higher domain blurring, greater work-life conflict, and intensified work stress (e.g., Köffer et al. 2014a; Wang and Zhang 2015; Yun et al. 2012). To date, most of these studies on IIS as a boundary management tactic

have focused on the smartphone as a representative device of a socio-technical IIS that fosters domain integration. What these studies have not done, however, is investigate IIS as a whole (Duxbury et al. 2014; Yun et al. 2012). There is, as yet, no appreciation that integration lies on a continuum between complete integration and complete segmentation (Köffer et al. 2015). The purpose of this study is to extend the literature by taking a holistic view on IIS and addressing the following research question:

How can IIS integration be conceptualized, and which components of an IIS have to be considered?

To let us better envision IIS components, we consider a fictional character named "Bob." Bob serves as an amalgamation of ten qualitative user interviews that we conducted in advance to understand better and illustrate the issue of IIS integration. All interviewees are employees of one knowledge-intensive organization with the same equipment characteristics as a business notebook, business cellphone, etc. So, we build the basic structure of Bob. However, some features were different from other interviewees. We have included these remarkable features in the example of Bob:

Bob is 31 years old and lives with his partner. He is a project manager with his own space at his company's office, yet he often works from home, where he uses a dedicated room as his home office. Bob has both a private and a business notebook but uses only his private device, be it for private or business purposes, and he does so at home as well as at the company's office. He uses his private smartphone for his work and private life, whereas he does not use his business smartphone at all. However, he plans to get a second SIM card, two different numbers, and different ringtones for his business and personal calls. Furthermore, he has a landline phone in his office. For private instant messages, he uses WhatsApp, whereas he uses Microsoft Teams for those related to business. In some urgent cases, he contacts colleagues via WhatsApp. For business video calls, he uses Microsoft Teams and Zoom. For his email correspondence, he has private and business email addresses. For social networking, he uses Facebook and Twitter. Bob's business project has its own Twitter account, and he is responsible for communicating news relating to this project. Occasionally, Bob uses YouTube for work-related research, but for the most part, he uses this channel to watch videos in his spare time. Bob has been working for this company for several years, and during this time, some of his colleagues have become close friends. He talks to them about his family and aspects of his private life, such as holidays. Conversely, he talks to his partner about his business projects.

In Bob's situation, three critical questions come to mind: Which structure can we discern in Bob's IIS? How does this IIS contribute to integrating or segmenting his private and business lives? What are the positive and negative consequences of how he handles this IIS?

Researchers have proposed different IIS conceptualizations, some varying in the sub-layers of an IIS, others in its sub-systems (e.g., Gaß et al. 2015; Lee et al. 2015). Our first step, therefore, is to conceptualize the four layers of an IIS based on the extant literature, whereupon we will conduct a qualitative pre-study and define IIS integration on each of the four layers. To test the nomological validity (Judd et al. 1991) of our conceptualized construct, we build a research model in line with

Ashforth et al. (2000). This model is itself tested based on survey data and thereby follows the guidelines that MacKenzie et al. (2011) set for construct measurement and validation. We find support for IIS integration on the four layers, and we find support for the measurement method. We also find that IIS integration is highest at the device level and lowest at the relationship level. Our results indicate the relevance of dedicated research into IIS integration, and they provide a frame of reference for its analysis and management.

One contribution of this paper is to be a proposal of a four-layer conceptualization of IIS, combining various views on the topic. The four layers are as follows: devices (i.e., hardware tools like smartphones or laptops), digital identities (i.e., the representation of the individual in different IT services by such means as an email address or a phone number), relationships (i.e., social ties with friends or colleagues via the technology layers of the IIS), and information (i.e., data processing on the technology layers of the IIS).

The second contribution of this paper is the conceptualization of IIS integration. Users can influence the amount of integration and segmentation of their private and business lives by changing how they use their IIS on its various layers. When they keep their PIS and BIS apart, the overlap of private and business domains tends to be notably smaller. Conversely, users can integrate the systems into the opposite domains—for example, by using the private devices and digital identities for private and business matters—to intentionally integrate their private and business lives. Our contribution to the literature, then, is the finding that the integration on the relationship layer has the most informative value on IIS integration as a whole.

The remainder of this paper is structured as follows: Section 2 sets up the theoretical foundation of boundary theory and IIS. Section 3 introduces the four layers of IIS and our conceptualization of IIS integration. Section 4 develops a research model and describes the design and operationalization of the survey along with its results. Section 5 discusses the findings, theoretical contributions, and practical implications for individuals, organizations, and IT designers. This fifth and final section also provides a perspective on future research.

2 Theoretical Background

For this paper, we build on two research streams, which we explain in this Chapter: boundary theory from social psychology and individual information systems from IS research. We then elaborate on the importance of considering the integration of different components when researching IIS and show how IIS research has previously incorporated knowledge from boundary theory into its theorizing on IIS.

2.1 Boundary Theory

Boundary theory emerged from social psychology and the organizational sciences. It posits that individuals perform different roles in different contexts. A role is defined as "the building block of social systems and the summation of the requirements with which such systems confront their members as individuals" (Katz and Kahn 1978,

p. 219 f.). To simplify their environment, individuals create and negotiate boundaries between their roles. These boundaries break up their lives into fragments, or so-called domains, each containing one or more roles. The two major domains are the private and the business domains (Ashforth et al. 2000; Nippert-Eng 1996; Rothbard et al. 2005).

Boundaries are everything that delimits the scope of a domain (Ashforth et al. 2000). Individuals use different tools and tactics to manage their boundaries; this can be time, space, behaviors, or physical artifacts, such as calendars, keys, or clothes. Teleworkers, for instance, often use time to divide their day into private time and business time. Alternatively, they use spatial boundaries by setting up one room solely for their business matters (Fonner and Stache 2012; Jahn et al. 2016; Kreiner 2006; Nippert-Eng 1996; Park and Jex 2011).

Creating boundaries causes higher domain segmentation, a state in which individuals create boundaries that are inflexible and impermeable. Domains are separated without any overlaps in time, space, artifacts, or activities. At the other extreme, domain integration denotes the state in which individuals deliberately design boundaries as flexible and permeable. In that case, individuals make "no distinction [...] between what belongs to 'home' or 'work' and when and where [one domain's roles] are engaged" (Nippert-Eng 1996, p. 567). Time, space, artifacts, and activities of the domains overlap entirely. While theoretically possible, however, integration and segmentation in these extreme forms are very rare. The real-life shaping of boundaries lies on a continuum between integration and segmentation, and individuals tend to find their comfort zone somewhere towards one of these poles (Ashforth et al. 2000; Kreiner 2006; Nippert-Eng 1996).

Integration and segmentation have three main consequences: domain blurring, the level of cross-domain interruptions, and the magnitude of transition between domains. Work-family blurring, for instance, is "the experience of difficulty in distinguishing one's work from one's family [domain]" (Desrochers et al. 2005, p. 460). Cross-domain interruptions occur when time spent in one domain is interrupted by an element belonging to the other, for instance, a private call from the wife or husband during business hours (Ashforth et al. 2000; Chen and Karahanna 2014). The magnitude of transition between two domains is the effort needed to psychologically and physically leave one domain and enter another (Ashforth et al. 2000). Higher domain integration leads to advanced domain blurring and more cross-domain interruptions, while higher segmentation leads to a greater psychological and physical magnitude of transition between the domains (Ashforth et al. 2000).

The most extensively researched consequence of domain integration is the so-called work-life conflict (also known as the work-family or work-home conflict). This conflict arises when "pressures from the work and family domains are mutually incompatible in some respect" (Greenhaus and Beutell 1985, p. 77). Desrochers et al. (2005), for instance, found an increasing effect of domain blurring on work-life conflict. Work-life conflict, in turn, can cause higher stress or strain and lower organizational commitment (Ahuja et al. 2007; Ayyagari et al. 2011; Yun et al. 2012).

It is worth noting, though, that domain integration does not automatically cause adverse effects, and this brings us to why an individual's preference for domain

integration or segmentation matters. The moderating effect of the individual's preference is often referred to as person-environment fit—the congruence between an individual's preference for integration and their experience of the actual degree of integration. A greater fit has positive consequences, such as more job satisfaction, higher organizational commitment, lower stress, and lower work-life conflict (Fonner and Stache 2012; Köffer et al. 2014a; Kreiner 2006; Rothbard et al. 2005).

2.2 Individual Information Systems

Alter (2008) studied existent definitions of IS with the result that the most conceptualizations of IS exclude the individual components. He defines IS as a "work system," "in which human participants and/or machines perform work (processes and activities) using information, technology, and other resources to produce specific products and/or services for specific internal or external customers." (Alter 2008, p. 451). With the choice of the term "work," he restricts the definition to merely business IS. This makes it difficult to consider such systems, whose design refers to wholly or partly leisure activities as well as business activities. Today, individuals are their own administrators and autonomously design ever more powerful and complex IS that are even larger and more complex than the organizational IS administrated by IT departments of the past (Baskerville and Lee 2013). It is therefore very important to look at the IIS as well.

An IIS is a specific IS type. Baskerville (2011a, p. 1) defines IIS as "an activity system in which individual persons, according to idiosyncratic needs and preferences, perform processes and activities using information, technology, and other resources to produce informational products and/or services for use by themselves or others." Gaß et al. (2015) suggest that an IIS has a variety of information and communication technology components, such as devices, services, applications, websites, and apps. Much like Baskerville (2011a), Gaß et al. (2015) further argue that the social context is important. What is more, they make the valid point that an individual has different IT identities in different contexts, each shaped by their values, attitudes, morals, knowledge, and skills (Gaß et al. 2015).

In attempts to identify the consequences of IIS, scholars have largely focused on the positives. On the personal side, these include increased autonomy, motivation, and ease of adoption. For organizations, they include higher adoption speed and greater employee availability (Dell and Intel 2011; Murdoch et al. 2010; Niehaves et al. 2012; Del Prete et al. 2011). Meanwhile, other studies have focused on the "dark side" of IIS. In their meta-analysis, Pirkkalainen and Salo (2016) summarized these studies and differentiated the adverse effects that individuals experience due to IS (rather than merely IIS) into four clusters: technostress, information overload, IT addiction, and IT anxiety. In addition to this classification, Pirkkalainen and Salo (2016) identified the contexts in which these four phenomena can be observed: the business or the private domain.

2.3 IIS Integration

With the growth of importance and versatility, IIS has also become increasingly useful for professional activities (Gaß et al. 2015). Nowadays, employees use their private devices for business purposes or business devices for private purposes. In extreme but not so rare cases, it can be that some devices from one domain substitute devices from another (e.g., smartphones). Each IIS is designed individually and different from another, depending on the requirements and needs of each individual and their context. But previous IS literature does not fully address these developments and lacks a holistic conceptualization of the IIS (Gaß et al. 2015). For example, research on consumerization (Moschella et al. 2004; Weiß and Leimeister 2012) has investigated IIS on an organizational level and focuses on the diffusion of technologies originally made for the usage in an organization. Research on individualization (Baskerville 2011a) describes a similar consumerization process on the individual level. Specifically, it has examined the reasons and consequences of privately owned IT used by employees for business purposes (e.g., Niehaves et al. 2012; Ortbach 2015; Ortbach et al. 2013). IT consumerization on individual level is one of two possible directions that IIS integration can take. The research in this area has found important consequences for individuals, such as increased flexibility and performance but also additional data privacy implications. As for organizations, the research has indicated similarly important consequences, such as advanced innovation in business processes but also a larger number of IT security issues and a loss of organizational control (Behrens 2009; Ortbach 2015; Weeger et al. 2015). To date, however, there is a certain gap in the IT consumerization literature when it comes to research on the impacts of an IIS in which the private and business domains are, to one degree or another, integrated.

As the business and private domains of life increasingly overlap and their boundaries become blurred, a comprehensive examination of both is necessary to identify how IIS integration affects the entirety of an individual's life. To date, such IIS integration has not been studied in sufficient depth, nor have the consequences of its varying degrees.

2.4 Boundary Theory in IIS Research

Boundary theory and its related constructs explain the effects of more or less integrated domains of life, yet the boundaries between them can be shaped and reshaped with a variety of strategies. IIS developed as a new possibility of managing these boundaries. With its help, individuals can connect to the private and the business domains, regardless of time or space, which is to say they can overcome traditional boundaries (Golden and Geisler 2007; Park and Jex 2011). As a result, the extent of an individual's overall domain integration can to some extent be determined by boundary management tactics. For instance, teleworkers may use two different rooms to segment their domains but may also use their computer in either of those rooms to write both business and private emails.

In response to this development, IIS-related boundary management has become a key topic in boundary theory and IS research (Duxbury et al. 2014; Fenner and

Renn 2010; Jahn et al. 2016; Köffer et al. 2015; Kreiner 2006). While social science researchers have analyzed IIS as a new boundary management tactic that can provide new ways of setting boundaries (Golden and Geisler 2007; MacCormick et al. 2012), IIS researchers have examined the more extensive integration of domains and its associated effects, such as greater domain blurring and more cross-domain interruptions (Chamakiotis et al. 2014; Koch et al. 2012; Köffer et al. 2014a). Further, integrated approaches combine knowledge from both disciplines to better understand the consequences of IIS integration and boundary management (e.g., Duxbury et al. 2014; Jahn et al. 2016).

With regard to boundary management, prior studies have defined a range of strategies. Jahn et al. (2016), for example, have distinguished between integration strategies that use information technologies, depending on whether their primary objective is segmentation, integration, or mediation between the two. Another example is the study of Duxbury et al. (2014) in the course of which they interviewed 25 professional knowledge workers about their individual smartphone use and how this affects their lives. The results indicated three different groups: integrators, who tend to integrate domains by use of their smartphone, segmentors, who tend to segment domains, and struggling segmentors, who only use their business devices during non-business hours if they feel pressure from their employer to do so.

Concerning the effects of IIS integration on individuals, multiple studies revealed that the shared use of devices or services for both private and business tasks had a notable impact on domain blurring, which was found to exacerbate the work-life conflict (Köffer et al. 2014a; Wang and Zhang 2015; Yun et al. 2012). This, in turn, has been associated with greater job stress (Yun et al. 2012). Meanwhile, Köffer et al. (2014b) concluded that IIS integration has a positive effect on job performance.

In summary, research at the intersection of boundary theory and IIS suggests that IIS has to be considered as an important new boundary management tool with the potential of affecting an individual's well-being in a meaningful way, yet there is more research to be done. So far, the literature on IIS and boundary theory has not yet addressed the fact that any real-life integration of those two domains sits on a continuum between complete integration and complete segmentation.

3 Conceptualizing IIS Integration

To measure IIS integration, we first define what components we mean by IIS. Therefore, we build our concept on the seminal studies by Lee et al. (2015), Gaß et al. (2015), and Baskerville (2011a). According to Lee et al. (2015), an IS is the combinational interplay of technology, information, and social artifacts. A technology artifact is understood to be a human-created tool (e.g., hardware or software) that is "used to solve a problem, achieve a goal or serve a purpose that is human defined, human perceived or human felt" (Lee et al. 2015, p. 8). An information artifact is "the instantiation of information, where the instantiation occurs through a human act either directly [...] or indirectly" (Lee et al. 2015, p. 8). A social artifact consists of "relationships or interactions between or among individuals" (Lee et al. 2015, p. 9) (see Fig. 1, left). Gaß et al. (2015) suggest that an IIS has a variety of informa-

tion and communication technology components and argue that the social context is important. Furthermore, they make the valid point that an individual has different IT identities in different contexts, each shaped by their values, attitudes, morals, knowledge, and skills (Gaß et al. 2015) (see Fig. 1, right).

Let us return to Bob. He uses his private smartphone in both his private and business lives. Therefore, he would be deemed to have a highly integrated IIS. However, he plans to use two different SIM cards with two different numbers and two different ringtones for his business and personal calls, and he might well set his phone to ensure that neither personal calls nor any private notifications get through to him during his working hours. He is, then, using technology to separate his PIS and BIS. Otherwise, some of his colleagues are also his friends, so their conversations and exchanged information cover both professional and private topics. To account for this blurring of boundaries, we need a more complex conceptualization of IIS integration, as Lee et al. (2015) and Gaß et al. (2015) do not fully reflect the example of Bob. With that in mind, Baskerville (2011a) notes that while IIS, like IS in general, consists of technology artifacts, information artifacts, and social artifacts, he further distinguishes between privately owned components and others that are provided by the employer. In other words, he distinguishes between two sub-systems of IIS: the PIS and the BIS.

3.1 Four-Layer-Definition of IIS

To ensure that our new concept is informed by the benefits of all these varying perspectives by Baskerville (2011a), Lee et al. (2015), and Gaß et al. (2015), we propose a multi-layer conceptualization. Accordingly, devices and digital identities make up the first two sub-layers of the technology artifact, which takes account of the technology components of Gaß et al. (2015). By devices, we mean the hardware tools used to process information, such as computers, smartphones, and telephones. In addition to the physical machinery, the layer devices also includes logical capabilities (e.g., operating system) that make the device functional (Yoo et al. 2010). Multiple services may run on one device, such as email, social networking, or telephoning, and each of these can be linked to different digital identities, such as private and business email addresses. Using one's private digital identity can indicate other attitudes or intentions than using the digital identity associated with one's business life, which is why we expand the understanding of digital identities. In our concept, they form the second layer of technology that bridges to social relationships. In summary, our four IIS layers are devices, digital identities, relationships, and information (see Fig. 1, middle). As noted, one device (e.g., a smartphone) can be used for multiple services (e.g., instant messenger, email), and these can be used with multiple digital identities (e.g., a private and a business email address). Together, these two layers of the technology artifact make it possible to interact in the different relationships that compose the third layer, while the fourth comprises the information that is transferred in the various relationships by the use of the technology artifact to the different relationships.

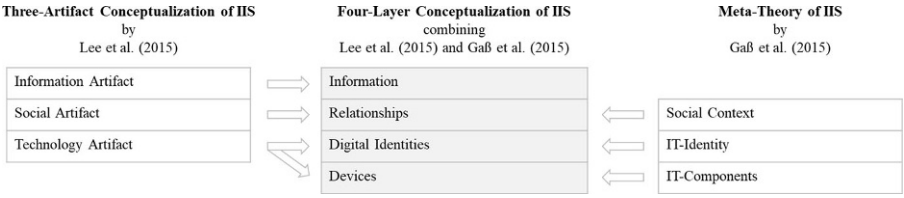


Fig. 1 The Four Layers of IIS

Each of the sub-systems of IIS (PIS and BIS) comprises these four layers, and each layer hosts different components (Baskerville 2011a). Fig. 2 shows the example of Bob's IIS.

3.2 Definition and Operationalization of IIS Integration

We define the integration of an IIS by the degree of overlap between its sub-systems (PIS and BIS). Complete IIS integration is the state in which the boundaries around PIS and BIS are entirely flexible and permeable. All components are used in all social domains, regardless of the domain from which they may originate. Conversely, complete IIS separation is the state in which PIS is only used in the private context, and BIS is only used in the business context.

Extant studies on IIS and boundary theory have focused on distinct IIS components, especially smartphones. To date, there has been no thorough analysis of the complete range of IIS components, yet we posit that consideration of IIS integration on four layers is essential since these different layers can be integrated to varying degrees. If we take another look at the example of Bob, we see that integration of his IIS may be designed in such a way that he does not have a business smartphone but instead uses his private smartphone for both private and business purposes. He may also use an email service in both contexts, yet he distinguishes between different digital identities as he only uses the private email address for personal messages, whereas he uses the business email address for professional correspondences.

Furthermore, Bob's example shows that there can also be a separate degree of integration on the relationship layer as he has a number of colleagues at work who have become friends with whom he will discuss matters that go beyond this domain, such as private vacation plans. In his private domain, meanwhile, he does likewise by talking about his current business projects with his partner, which lays credence to our claim that there is often a flexible integration of information. Only in exceptional cases does Bob's IIS integration tend towards an extreme of this dynamic continuum, be it complete integration or complete segmentation. For Bob, the information layer is highly integrated. The other layers lie in the range between those two extremes. Fig. 3 shows the example.

As indicated, integration and segmentation sit on a continuum. Only by determining the extremes of IIS integration can we interpret its extent. With complete IIS integration, private and business layers are used in equal frequency for matters relating to the user's private and business lives, which means they cannot be assigned to either domain exclusively. In contrast, IIS segmentation is the absence of

Layer	Private Domain	Business Domain
Information	Private Topics	Business Topics
Relationships	Family, Friends	Colleagues
Digital Identities	Private Mobile Number, Private Email Address, Private WhatsApp Account, Private Facebook Account, Private Twitter Account, Private YouTube Account	Business Mobile Number, Landline Telephone Number, Business Email Address, Business Twitter Account, Business Teams Account, Business Zoom Account
Devices	Private Smartphone, Private Notebook	Business Smartphone, Business Telephone, Business Notebook

Fig. 2 Four Layers of IIS, as exemplified by "Bob"

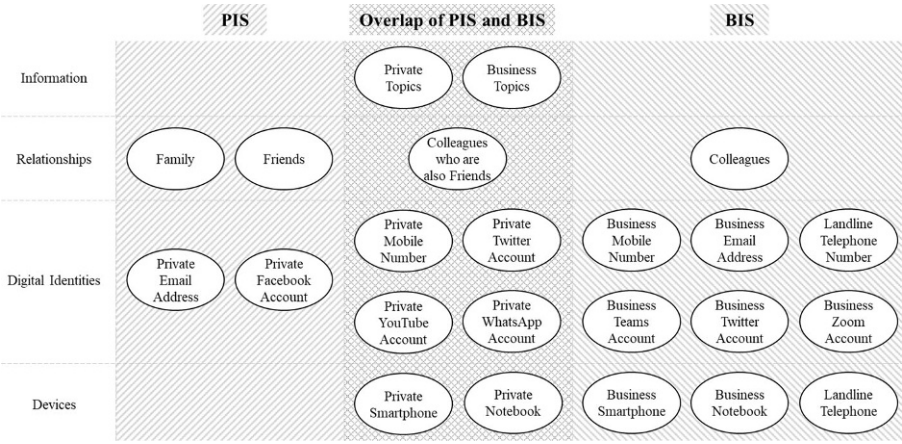


Fig. 3 Integration of IIS as seen in the example of Bob

IIS integration. In that case, the layers are used entirely for matters concerning their respective domain. Accordingly, IIS integration is the extent to which the PIS components and the BIS components are used equally often for private and professional matters.

Let us then turn to the measuring of IIS integration. An IIS has multiple layers, upon each of which it may host multiple components. Integration should first be measured for each of these components separately, whereupon they can be aggregated to one measure of integration for each layer and finally an overall IIS integration measure.

Let L be the set of layers: devices (*dev*), digital identities (*digid*), relationships (*rel*), and information (*info*). For each $l \in L$, let C_l be the set of components on layer l. Let u_c^p be the usage frequency of component $c \in C_l$ for private matters and u_c^b its usage frequency for business matters, both measured on a non-negative scale.

Given that c is a component of the IIS, we assume that it is indeed used and that the usage frequency measure is therefore strictly positive for at least one of the two sub-systems. With this in mind, we calculate the integration of a component c as the division of the usage frequency of the less used component ($\min(u_c^p, u_c^b)$) by the usage frequency of the more used component ($\max(u_c^p, u_c^b)$). Accordingly, we calculate it as

$$\mathrm{doi}_c = \frac{\min\left(u_c^p, u_c^b\right)}{\max\left(u_c^p, u_c^b\right)} \tag{1}$$

$$\mathrm{doi}_c \in [0.1] \tag{2}$$

We denote it as *doi* for *degree of integration* to point to the continuous nature. To clarify matters, we refer to the following example of how to calculate the degree of a device's integration: The usage frequency of the device is measured on a scale from 0 ("never") to 4 ("every day"). For business purposes, the usage frequency is 4. For private purposes, the usage frequency is 1. Accordingly, the degree of integration for this device is calculated as

$$\mathrm{doi}_{\mathrm{device}} = \frac{\min\left(u_c^p, u_c^b\right)}{\max\left(u_c^p, u_c^b\right)} = \frac{1}{4} = 0.25 \tag{3}$$

After calculating the degree of integration for each component (doi_c), we aggregate by layer. If one component was not used at all, the integration is the aggregation of the other components. Specifically, we build a weighted mean of each component's integration, considering each component's usage frequencies. This means that if, for instance, one device is used more often than another, its degree of integration accounts for more in the overall extent of device integration. This results in the following measure:

$$\mathrm{DOI}_l = \frac{\sum_{c \in C_l} \left[\mathrm{doi}_c \cdot \left(\boldsymbol{u_c^p} + \boldsymbol{u_c^b}\right)\right]}{\sum_{c \in C_l} \left(\boldsymbol{u_c^p} + \boldsymbol{u_c^b}\right)} \tag{4}$$

$$\mathrm{DOI}_l \in [0.1] \tag{5}$$

4 Empirical Assessment

The purpose of this assessment is to test not only our (four-layer-)conceptualization of IIS but also our concept of IIS integration and our measurement method. We do so by evaluating the construct's nomological validity, which "is demonstrated when the empirical relationships observed with a measure match the theoretically postulated nomological net of the construct" (Judd et al. 1991, 56 f.). To this end, we build a research model based on the theoretical assumptions about boundary theory, as formulated by Ashforth et al. (2000).

We then design an online survey for an empirical analysis of the research model. This allows us to evaluate the model's qualitative assumptions with quantitative

data. It also allows us to compensate for the lack of secondary data with a suitable alternative since surveys are one of the most commonly used research methods in IS research (Palvia et al. 2015). We opt for online data collection for its efficiency and facilitation of high respondent numbers, which enhances the general validity of our results. To avoid potential hazards of online surveys, such as various biases, we take appropriate measures to mitigate their effect.

4.1 Model Development

Our conceptual model applies aspects of boundary theory in the context of IIS. The model's central paradigm is that the integration of PIS and BIS is a technological boundary management tactic (Nippert-Eng 1996). Integrating both sub-systems of an IIS means designing the boundaries between the social domains as flexible and permeable. Yet, while flexible boundaries facilitate more efficient domain changes, this flexibility may also overwhelm individuals when private and business domains fuse unintentionally. In line with boundary theory's central idea (Ashforth et al. 2000), IIS integration causes not only domain blurring but also cross-domain interruptions along with a greater psychological and physical magnitude of transition between domains.

Creating a highly integrated IIS may blur the boundaries between domains since it becomes harder to ascertain which role of a given domain one is to enact when using such an IIS. It may also cause more cross-domain interruptions as there are no distinct sub-systems but rather one overall integrated IIS. Accordingly, one cannot entirely leave or switch off one sub-system. For instance, as Bob uses one smartphone for both private and business matters, it can easily happen that a work call interrupts dinner with his girlfriend, which would constitute a cross-domain interruption. When put on the spot like that, he may also get confused about which role to enact when responding to the caller, which would constitute domain blurring. Developing the ideas of Ashforth et al. (2000), we hypothesize:

H1 Higher IIS integration is positively related to higher domain blurring.

H2 Higher IIS integration is positively related to more cross-domain interruptions.

Regarding the magnitude of transition between the domains, there is a difference between the physical and psychological magnitude (Ashforth et al. 2000). We expect higher IIS integration to be negatively related to the physical magnitude of transition since the individual does not have to make a physical switch to the other sub-system. Instead, the integrated IIS enables Bob to deal with some business matters at home. Contrary to this, we expect a higher IIS integration to be positively related to the psychological magnitude of transition. Individuals make the psychological transition between domains by developing certain habits that Ashforth et al. (2000) call transition scripts. Consciously changing from BIS to PIS could be such a transition script as it requires a certain mental effort to facilitate the transition. In short, if IIS integration is high, there is a less conscious transition between domains as with a highly segmented IIS, which would mean that there is a lower magnitude of psychological transition. With this in mind, we hypothesize:

H3 Higher IIS integration is negatively related to the physical magnitude of transition.

H4 Higher IIS integration is positively related to the psychological magnitude of transition.

The definitions of the model's constructs can be found in Table 1.

We also include several control variables in our empirical analysis. The first two are the segmentation preferences to keep the business domain separate from the private domain and vice versa. These variables have been extensively discussed with regard to both IIS integration and boundary theory (Köffer et al. 2014a; Kreiner 2006; Rothbard et al. 2005; Yun et al. 2012). We further include three variables that affect how an individual interprets their responsibilities in either the private or the business domain. Accordingly, they are significant factors that affect the interplay of the two domains. These three variables are the weekly working hours, the number of children, and the number of cohabitants in the individual's household. Finally, we include gender and age as two additional control variables.

4.2 Measurement Development and Data Collection

We followed the guidelines set out by MacKenzie et al. (2011) to develop and validate measures for IIS integration as well as the dependent variables of our research model.

In the first step, we developed a conceptual definition of the construct (Sect. 3). In the second step, we generated items to represent IIS integration on each of the layers. For device integration and digital identity integration, we formulated our own items in accordance with the standard guidelines agreed upon by Hinkin (1998), MacKenzie et al. (2011), and Tourangeau et al. (2000). For the integration of relationships, we adopted Nippert-Eng's (1996, p. 577) definition, according to which "co-workers come to home to socialize with family; family comes to workplace to socialize/work with co-workers." On the understanding that private relationships should not be restricted to family, we expanded the definition to include "family and friends." For information integration, we adopted the item scale proposed by Clark (2002).

When selecting the model's dependent variables, we adopted certain items from the literature, those for domain blurring from (Desrochers et al. 2005) and those for cross-domain interruptions based on the work of Chen and Karahanna (2014). Since the extant literature did not provide a validated scale for the psychological and physical magnitude of transition, we created two items for each, based on the definition by Ashforth et al.'s (2000). With regard to segmentation preference, we used Kreiner's (2006) item scale. Further, we included two theoretically unrelated marker variables to account for common method bias. All items were measured on a seven-point Likert scale. See Appendix A for an overview.

All constructs except for the IIS integration are reflective constructs. IIS integration is a formative construct that builds on the four manifest variables of device integration, digital identity integration, relationship integration, and information integration. Those four manifest variables were computed, as explained in Sect. 3.3.

Table 1 Construct Definitions

Construct	Definition	Source
IIS Integration	The degree of overlap in the use of the IIS sub-systems (PIS and BIS)	Self-developed
Domain Blurring	"The experience of difficulty in distinguishing" one domain from another	Desrochers et al. (2005, p. 460)
Cross-Domain Interruptions	The experience of having one domain intrude into another	Ashforth et al. (2000); Chen and Karahanna (2014)
Physical Magnitude of Transition	The effort required to leave one domain to enter another physically	Ashforth et al. (2000)
Psychological Magnitude of Transition	The effort required to leave one domain to enter another psychologically	Ashforth et al. (2000)

To assess content and face validity of the item scales, we conducted a card sorting among fellow researchers (Moore and Benbasat 1991; Thatcher et al. 2018). We asked participants to match the items to the definition of each layer integration in an online mask. Sixteen participants completed the task. Participants matched 38 of the 44 items correctly by a percentage of at least 80%. We reviewed the other six items and reformulated them according to the participants' feedback so as to do full justice to the content of the respective construct.

Next, we designed an online survey to collect data and empirically test our measures of the various constructs of the research model as well as the demographics. We restricted participation to currently or recently employed or self-employed individuals since the survey sought to collect data concerning both domains. We recruited participants from the United States via the online crowdsourcing market, Amazon Mechanical Turk (MTurk), an internet-based platform to recruit participants for small tasks, such as the participation in a survey (Steelman et al. 2014). This platform has already been used in several IS studies (e.g., James et al. 2019; Kehr et al. 2015; Lowry et al. 2016) and studies on the population of MTurk participants have shown that they are not different from populations of other internet-based recruited samples based on different psychometric scales (Buhrmester et al. 2011). However, to ensure data quality, we executed different measures, such as an instructional manipulation check (Oppenheimer et al. 2009), an attention check, and free text questions to identify unusual comments (Chmielewski and Kucker 2020). Further, respondents were paid a small incentive for participation in the study. Following the recommendations of Hair et al. (2014), we aimed to achieve a sample size of at least 191 respondents. Of the respondents who took part in this study, 205 provided data that met our quality guidelines. 36% of the respondents were female. The average age of the respondents was 37 years.

4.3 Results

4.3.1 Measurement Model

For scale purification and refinement, we assessed our measurement model by structural equation modeling (PLS-SEM) using SmartPLS 3.0 and followed the sugges-

tions of Hair et al. (2014). When it came to assessing the formative measure for IIS integration as the extent of integration on the four layers, we examined content validity by performing a "subjective but systematic evaluation of how well the domain content of a construct is captured by its indicators" (Hair et al. 2014, p. 115). Based on the theoretical derivation and our card sorting, we deemed the content valid. We then assessed the indicators for collinearity by checking whether each indicator's variance inflation factor (VIF) value was lower than 5.0 (Hair et al. 2014). Our data fulfilled this criterion. We also examined the indicators' outer weights and outer loadings. Regarding the former, only the outer weight of relationship integration was significant. However, based on the recommendations of Hair et al. (2014) and Cenfetelli and Bassellier (2009), we retained all four indicators, as their outer loadings were all significant and higher than 0.5. See Appendix B for an overview of the constructs' outer weights and loadings and the indicators' correlations.

The outer weights and loadings also revealed that the relationship layer is of highest importance for the construct, with an outer loading of 0.994. This may imply that the other three layers could be omitted from the construct. However, the nature of formative constructs is that the indicators only together determine the meaning of a construct since "each indicator [...] captures a specific aspect of the construct's domain" (Hair et al. 2014, p. 43). Thus, we decided to retain all four indicators since they reflect the four theoretical layers of IIS integration, but to analyze the issue once again when testing the structural model (see last paragraph of Sect. 4.3.3).

To assess the reflective measures of domain blurring, cross-domain interruptions, psychological magnitude of transition, and physical magnitude of transition, we started by examining internal consistency reliability. According to Hair et al. (2014), this is best assessed via composite reliability (CR), which should be higher than 0.708. All of our constructs exceeded this threshold. With a view to convergent validity, we examined indicator reliability and average variance extracted (AVE). To assess indicator reliability, we checked each indicator's outer loadings. All of them were found to be over the expected 0.708. Also, AVE turned out to be satisfactory, since the minimum AVE for all constructs was measured at 0.747 (Hair et al. 2014).

For discriminant validity, we first examined each indicator's cross-loadings with all other constructs to check whether they were lower than the indicator's outer loading on the construct. Our data met this criterion. We then made sure that each construct's square root of the AVE was higher than the highest correlation with other constructs (Fornell-Larcker criterion). Discriminant validity is therefore supported. Table 2 shows means, standard deviations (SD), and CR values as well as the AVE values for all constructs. Information on control variables, (cross-)loadings, and the Fornell-Larcker criterion can be found in Appendix C.

Since the item scales had already met the quality criteria, we did not collect a new sample, as suggested by MacKenzie et al. (2011). Instead, we finalized the process by assessing nomological validity, which will be presented in Sect. 4.3.3.

Table 2 Descriptive Statistics, Main Factor Loadings, Internal Consistency, and Average Variance Extracted

	No. of Items	Mean	SD	Loadings	CR	AVE
IIS Integration	4	0.626	0.279	0.564–0.994	–	–
Domain Blurring	2	4.568	1.885	0.857–0.897	0.870	0.770
Cross-Domain Interruptions	2	4.198	1.998	0.863–0.866	0.855	0.747
Psychological Magnitude of Transition	4	3.990	2.015	0.878–0.903	0.940	0.797
Physical Magnitude of Transition	4	3.990	2.011	0.868–0.910	0.939	0.795

4.3.2 Initial Statistics On IIS Integration

We calculated the degree of integration for each layer with the aforementioned method. First, we assigned values of 1 to 7 to the seven-point Likert scales that we used to ask about usage frequency of devices and digital identities and integration of relationships and information. See Fig. 4 for the corresponding histograms. Table 3 provides an overview of the mean and standard deviations for the four layers divided by gender, age, marital status, and weekly working hours. We also tested for significant differences between the groups, displaying the *p*-values of the unpaired t-tests and the analysis of variance (ANOVA).

The results differ by IIS layer. The device layer shows the highest mean of 0.708, followed by digital identities with a mean of 0.641. Respondents use many devices for both business and private matters, and sometimes they use different digital identities on these devices to attend to different matters. As for the relationship and the information layers, both show relatively high mean integration values of 0.554 and 0.603. Respondents often talk or exchange messages with their family/friends and colleagues about business as well as private matters.

Our results show no significant gender differences between IIS layers. Regarding age, however, we can see a significant difference in digital identity integration. The highest rate was found among respondents between the ages of 45 and 54, followed by the age group of 25 to 34. An interesting observation worth noting here is that respondents who work less than 30 h per week tend to integrate their digital identities and relationships more than full-time employees do. Often, they use a private digital identity like a smartphone number or email address in the business domain and vice versa. Furthermore, they tend to have more friends among their colleagues.

4.3.3 Structural Model and Testing of the Hypotheses

The structural models were not impaired by collinearity issues, as indicated by all VIF values being lower than 5.0. See Fig. 5 for the model estimates.

IIS integration was found to be positively related to domain blurring, cross-domain interruptions, and psychological magnitude of transition, which lays credence to H1, H2, and H4. However, it is also positively related to the physical magnitude

Table 3 Mean, Standard Deviation, and Results of Tests for Significant Differences of DOI

		Device Integration			Digital Identity Integration			Relationship Integration			Information Integration		
	N	Mean	SD	*p*-value	Mean	SD	*p*-value	Mean	SD	*p*-value	Mean	SD	*p*-value
Total													
–	205	0.708	0.282	–	0.641	0.331	–	0.554	0.266	–	0.603	0.203	–
Gender[a]													
Female	73	0.715	0.294	0.793	0.657	0.329	0.613	0.525	0.286	0.273	0.592	0.229	0.579
Male	132	0.704	0.276		0.632	0.333		0.569	0.253		0.609	0.187	
Age[b]													
Under 25	4	0.595	0.366	0.361	0.284	0.396	0.043*	0.514	0.305	0.088	0.583	0.134	0.511
25 to 34	109	0.732	0.252		0.682	0.303		0.591	0.238		0.61	0.183	
35 to 44	44	0.709	0.294		0.568	0.365		0.48	0.278		0.563	0.217	
45 to 54	22	0.714	0.323		0.704	0.307		0.601	0.315		0.655	0.251	
>54	26	0.614	0.328		0.594	0.358		0.485	0.283		0.601	0.221	
Marital Status[b]													
Single	38	0.701	0.265	0.003**	0.618	0.343	<0.001***	0.529	0.297	<0.001***	0.578	0.205	0.007**
In a Relationship	14	0.580	0.262		0.470	0.307		0.417	0.275		0.530	0.171	
Married	143	0.742	0.271		0.690	0.314		0.594	0.244		0.629	0.186	
Divorced	8	0.426	0.360		0.235	0.239		0.274	0.168		0.451	0.355	
Widowed	2	0.401	0.313		0.439	0.480		0.236	0.334		0.302	0.280	
Weekly Working Hours[a,c]													
<30	23	0.755	0.256	0.346	0.783	0.179	0.001**	0.653	0.229	0.037*	0.629	0.215	0.565
30 or more	180	0.700	0.286		0.625	0.34		0.540	0.269		0.602	0.202	

* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$
[a] *p*-value of unpaired t-test
[b] *p*-value of ANOVA
[c] N = 203 owing to missing information

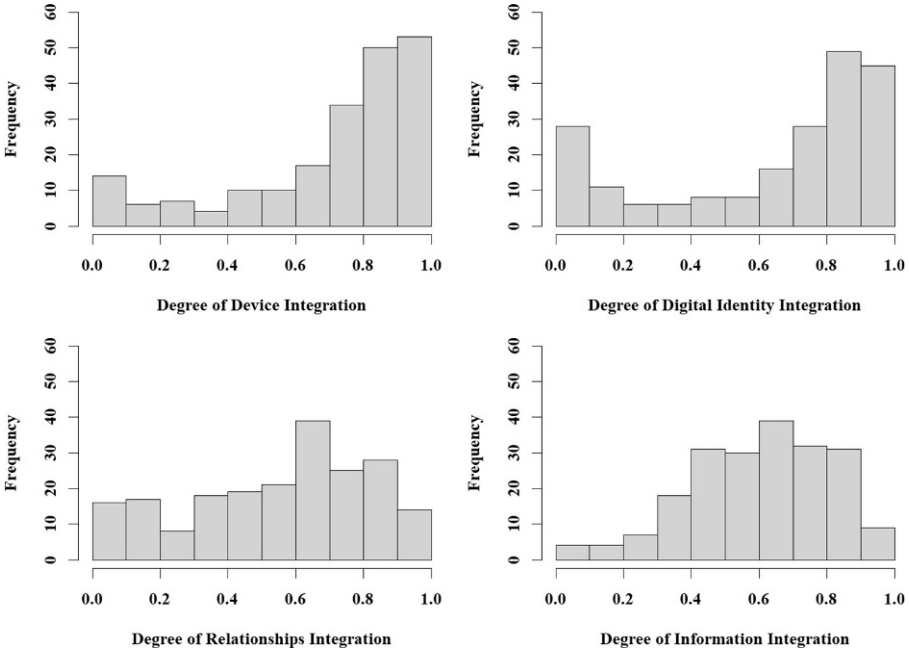


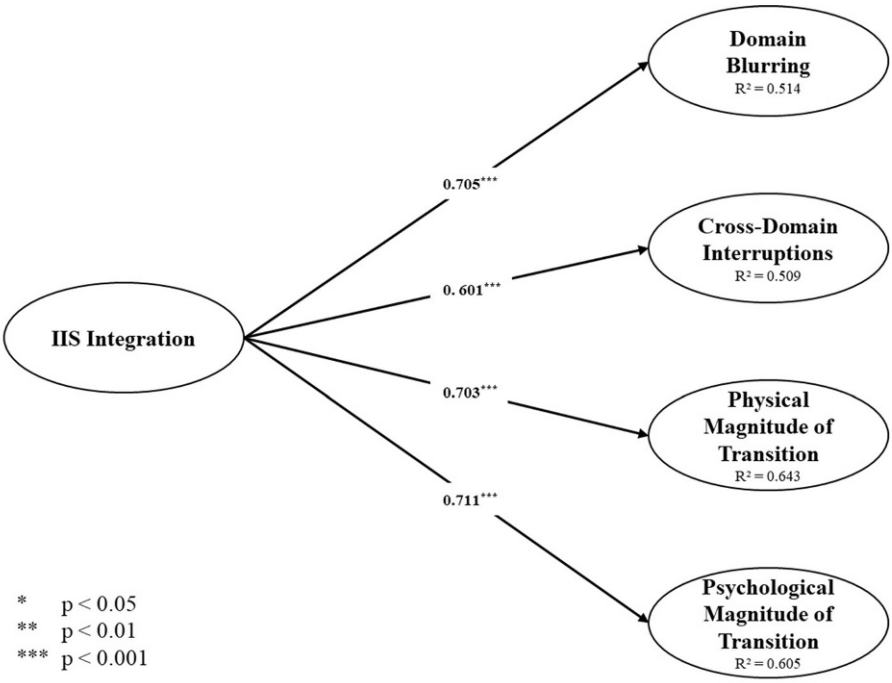
Fig. 4 Histograms showing the degrees of integration for all Four Layers ($n = 205$)

of transition, rather than negatively, as posited in H3. Results for control variables can be found in Appendix D.

To further validate our findings, we first screened our data for non-response bias by separately analyzing the model for the first and second halves of our group of respondents (Armstrong and Overton 1977). We found no indication of non-response bias.

Second, we checked for common method variance (CMV) by employing the correlational marker technique as a post hoc test (Lindell and Whitney 2001; Richardson et al. 2009). We partialled out the smallest and the second-smallest shared variance in bivariate correlations among substantive exogenous latent variables. Since we found only minor changes in significance of the bivariate correlation among these variables, we deem CMV not to be a concern in this study. Furthermore, we implemented the correlational marker technique with a theoretically unrelated marker variable (Lindell and Whitney 2001; Richardson et al. 2009). Again, partialling out the smallest and second-smallest shared variance between the marker and the substantive exogenous variables resulted in no substantial changes in significance of bivariate correlations. There is, then, no evidence to indicate CMV in our study.

Third, we conducted a robustness check on our measurement method by changing one of its specifications. As proposed, we calculated the *DOI* by weighting the partial integrations (*doi*) with the usage frequency. For the robustness check, we built an unweighted mean. We ran the PLS algorithm with the unweighted DOIs and found the same significant relationships. This finding lends further support to the rationale of our measurement method, which is to calculate the extent of IIS integration by



Controls: Work from Private Segmentation Preference, Private from Work Segmentation Preference, Weekly Working Hours, Number of Children, Number of Cohabitants, Gender, Age

Fig. 5 Model Results

putting each component's usage frequency for one domain into a relationship with the other domain's usage frequency, seeing as changing one subordinate specification did not alter the results.

Fourth, to further test whether all layers are important we ran four separate models measuring IIS integration with only one of the IIS layers each to test whether all layers individually are related to the dependent variables (see Table 4). The results show that each layer itself shows significant relations with the four dependent variables. However, the path coefficients within the primary model, including all four indicators, are only slightly higher than in the model including only relationship integration (Model 4), thus indicating that adding the other three indicators does not increase the path coefficients substantially.

These results from comparing the models together with the high loadings of relationship integration as compared to the lower loadings of the other layers lead us to the conclusion that only the relationship layer is necessary for explaining outcomes of IIS integration. While we theoretically conceptualized four layers of IIS, only one of them is necessary for explaining the consequences of the integration of IIS. We will discuss this issue in the following discussion section.

Table 4 Model Comparison with Different Subsets of IIS Integration Layers

	Path Coefficients									
	Model 1		Model 2		Model 3		Model 4		Model 5	
Operationalization of IIS Integration	All four indicators		Only device integration		Only digital identity integration		Only relationship integration		Only information integration	
IIS Integration → Domain Blurring	0.705	***	0.354	***	0.372	***	0.696	***	0.499	***
IIS Integration → Cross-Domain Interruptions	0.601	***	0.236	***	0.289	***	0.599	***	0.398	***
IIS Integration → Physical Magnitude of Transition	0.703	***	0.304	***	0.376	***	0.703	***	0.498	***
IIS Integration → Psychological Magnitude of Transition	0.711	***	0.291	***	0.443	***	0.695	***	0.446	***

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

5 Discussion

For our conceptualization of IIS and IIS integration, we distinguished between four layers of IIS, defined IIS integration as the overlap of IIS sub-systems from the private and business domains, and developed a measurement method to quantify the integration. We also developed a theoretical model for the effects of IIS integration and assessed this by means of a thorough empirical study.

5.1 Discussion of Results On IIS Integration

Building on existing literature and our preliminary interviews, we conceptualized IIS as a composite of four layers: devices, digital identities, relationships, and information. However, when looking at the integration of an IIS, relationship integration was found to have the most informative value on IIS integration as a whole, while the other three layers do not contribute to explaining the outcomes as much. This is interesting as it implies that regardless of the technological (i.e., devices and digital identities) and information layers of IIS, the most important factor for determining whether business and private lives overlap seems to be the relationships the individual interacts with. This might be because integration on the relationship layer manifests integration on the other layers to some extent representing the in-

dividual's real-world relationships within the IIS. If, for example, an individual has a colleague who has also become a close friend over the years, the individual will talk to this colleague/friend about business- as well as private-life-related topics (thus, information integration is affected). For communicating with the colleague/friend, the individual might not so much differentiate whether the shared business information is only communicated via business devices and digital identities and vice versa. These findings align with representation theory, which states that information systems are representations of domains (Wand and Weber 1995; Burton-Jones et al. 2017). Regarding IIS integration, IIS are representations of the individual's real-world relationship. This also adds to the recent discourse brought up by Baskerville et al. (2020), that today, digital technologies shape the physical reality, indicating that for IIS and IIS integration, in our case, the real-world still shapes the digital representation. Thus, we conclude that even though IIS are composed of four different layers, only the relationship layer is of interest when it comes to IIS integration.

5.2 Theoretical Contributions

Our first theoretical contribution is the definition of four IIS layers. We arrived at this by building on the work that Baskerville (2011a) did in the field when defining IIS. We also drew on the research of Lee et al. (2015) to extend their three-layer definition of IS to IIS. Furthermore, we included the notions of Gaß et al. (2015). Our definition allows researchers to understand IIS better since the four layers can be analyzed and designed separately. Together, these contributions inform the as yet somewhat fledgling research on IIS and bolster its significance within the field of IS.

This study's second contribution to the literature is the finding on IIS integration, as this had merely been examined on certain parts of an IIS without accounting for all layers. While we first conceptualized IIS integration as the degree of overlap between its sub-systems on all four layers, we came to the conclusion that IIS integration is represented by the integration on the relationship layer alone throughout the empirical investigation. This conclusion adds to research on IT consumerization, investigating the use of privately-owned devices and digital identities for business purposes (i.e., integration of devices and digital identities) (e.g., Köffer et al. 2014a; Ortbach 2015; Ortbach et al. 2013). Our findings bring a new perspective on why individuals engage in IT consumerization, as the reason for this may first and foremost lie in the relationships that are present in both domains of life. Also, outcomes of IT consumerization, such as blurring domains, may not be because of the IT consumerization itself but because of the underlying relationship integration. Hence, future researchers would be well-advised to take this forward, conduct further investigations, and investigate how relationship integration and integration on the other layers are related. Even though relationship integration appears to manifest the integration of the other IIS layers, we can observe some people preferring to use two separate smartphones for communicating with the same relationships—depending on whether the communication is business- or private-related. Exploring the reasons for these differences is a promising avenue for future investigation. For this, our

method for measuring integration on the different layers can be used to empirically investigate the relationships and effects of the single layers of IIS integration.

Also, our study focuses on the two major domains of life: the private and the business. Our conceptualization, however, can be adapted to other domains. It can be used to examine sub-domains of the private domain, such as the family domain or the domain of one's engagement in charity. Likewise, it can be used to differentiate between sub-domains of the business domain, such as the domains of different organizational teams of which the individual is a member.

We made the third theoretical contribution of this study by being able to confirm the impact that IIS integration has on boundary theory constructs, such as blurring and interruptions, since, in doing so, we found support for the transfer of boundary theory to IIS research. In this context, it is also worth noting that this study contributes to boundary theory by revealing and demonstrating the relevance of IIS as a boundary management tactic to be deployed in tandem with the more traditional tactics. Further worth mentioning are the exploratory findings this study provides on the relationship between the extent of IIS integration by layer and gender, age, marital status, and working hours. It is our hope that these findings will inform future developments in IIS theory.

5.3 Practical Implications

Our results suggest different practical implications for individuals, organizations, and IT designers. Individuals must understand the various ways in which their integration of relationships affects several outcomes, such as blurring and cross-domain interruptions. They must also understand that we all differ in the extent of integration that we deem to be most efficient and suitable to ourselves. Further complicating matters is the fact that the individual user depends on the options to construct an IIS that a device provider like their employer offers. Some employers will not allow the use of business smartphones or notebooks for private purposes. There can, then, be a gap between an individual's intention to construct a bespoke IIS and the opportunities available to do so in the employment context. It is, therefore, in each individual's interest to explore the various positive and negative ramifications along with the opportunities to construct a personalized IIS within the parameters of their organizational or social environment.

Organizations, meanwhile, should be aware that their employees may differ considerably in what they deem to be the optimal extent of integration depending on the extent of their relationship integration. A supportive employer will, therefore, enable employees to create their technical and information layers of the IIS as integrated or segmented as they prefer to match the real-world relationship integration. Potential ways to facilitate such flexible IIS integration are so-called "bring your own device policies." Other options include allowing private use of business email and clearly defining which work-related information may be shared with family and friends. Furthermore, organizations might also want to consider allowing their employees to keep their respective IIS segmented. If employees are given the means and liberty to optimize the extent of their individual IIS integration, their improved personal well-

being may prove beneficial to their professional performance and thus also pay off for their employer.

The best way for IT designers to offer similarly effective support in constructing an individual's optimized IIS is by providing technology that allows users to switch between integration and segmentation. For instance, smartphones should be able to distinguish if a call is related to a private- or business-related matter. This would allow the user to decide whether or not a cross-domain interruption is desirable or indeed permissible at a given time or place.

5.4 Limitations and Conclusion

Like all research projects, this study is subject to certain limitations. We measured the integration of IIS by the respondents' self-reported usage frequency of IIS components. Future research could advance data collection to measure IIS integration objectively. One possible way of doing so would be automated device and digital identity usage measurement. Another limitation in our measurement are the used marker variables to test for common method variance. Both variables were self-developed and not subject to scale development in prior research.

Furthermore, we did not differentiate between the directions of IIS integration. We did not differentiate between private IIS components extending into the business domain and vice versa. Future researchers might do well to broaden the understanding of IIS integration in that regard. They might also do well to expand the data collection, seeing as we restricted it to communication as the main use case of IIS. Although communication is an important use case in both business and private domains, further studies could yield interesting insights by measuring the integration of IIS as a whole. Furthermore, there are dynamic developments that impact the operationalization of IIS integration. Approaches such as Apple's new focus feature change the way how individuals use diverse information systems and offer them more opportunities to separate their private domains from their business domains and vice versa (Apple 2021). Further research should address the impact of these developments on the operationalization of our four-layer model.

By way of conclusion, it remains only to say that, in this study, we introduced four layers of IIS, conceptualized IIS integration, and presented a measurement model for IIS integration. Since both private and business domains will remain important to individuals, future researchers should continue to investigate the reasons for IIS integration and its various ramifications. In doing so, they should be guided by the purpose of providing individuals with solutions to manage IIS integration on each of its four layers, solutions that should also enable users to consciously define the extent of IIS integration that is ideally suited to them individually so as to reduce adverse effects.

6 Appendix

6.1 Appendix A

Table A.1 Survey Questionnaire

Device Integration (source: self-developed)	
INT01_01	Please indicate how often you use your private device x[a] for your private communication
INT01_02	Please indicate how often you use your private device x[a] for your business communication
INT01_03	Please indicate how often you use your business device x[a] for your private communication
INT01_04	Please indicate how often you use your business device x[a] for your business communication
Digital Identity Integration (source: self-developed)	
INT02_01	Please indicate how often you use your private account x[b] or numbers for your private communication
INT02_02	Please indicate how often you use your private account x[b] or numbers for your business communication
INT02_03	Please indicate how often you use your business account x[b] or numbers for your private communication
INT02_04	Please indicate how often you use your business account x[b] or numbers for your business communication
Relationship Integration (source: self-developed based on Nippert-Eng 1996)	
Integrating business relationships into the private domain	
INT03_01	I often meet co-workers privately
INT03_02	My circle of friends also consists of co-workers
INT03_03	My circle of family also consists of co-workers
Integrating private relationships into the business domain	
INT03_04	I often meet family members at my office or for job-related matters
INT03_05	I often meet friends at my office or for job-related matters
INT03_06	Some of my friends or family members are also my co-workers
Information Integration (source: Clark 2002)	
Integrating business information into the private domain	
INT04_01	I talk about my work schedule with my family
INT04_02	I talk with my family about work projects that require me to spend extra time at work
INT04_03	I discuss my work obligations with my family
INT04_04	I discuss work demands with my family
INT04_05	I tell my family about my current work projects
INT04_06	I share pleasant things that happened at work with my family
INT04_07	I share unpleasant things that happened at work with my family
INT04_08	I talk with my family about what kind of day I had at work

Table A.1 (Continued)

Integrating private information into the business domain	
INT04_09	I talk about my family schedule with my supervisor
INT04_10	I talk with my supervisor about family activities that may require me to spend extra time at home
INT04_11	I discuss my family obligations with my supervisor
INT04_12	I discuss home demands with my supervisor
INT04_13	I talk about my current family activities at work
INT04_14	I share pleasant things that happened at home with others at work
INT04_15	I share unpleasant things that happened at home with others at work
INT04_16	I talk with others at work about what kind of day I had at home
Domain Blurring (source: Desrochers et al. 2005)	
BLU01	It is often hard to tell where my work life ends and my private life begins
BLU02	I tend to integrate my work and private duties when I work at home
	I have a clear boundary between my career and my roles as a private person.[c]
Cross-Domain Interruptions (source: Chen and Karahanna 2014)	
INT01	During non-work hours, I am often interrupted by colleagues/other work contacts about work-related matters
INT02	During work hours, I am often interrupted by family/friends/other non-work contacts about non-work-related matters
Psychological Magnitude of Transition (self-developed based on Ashforth et al. 2000)	
PSY01	It is hard for me to psychologically switch from my private roles to my business roles
PSY02	It is hard for me to psychologically switch from my business roles to my private roles
PSY03	Switching from my private roles to my business roles takes a lot of psychological effort
PSY04	Switching from my business roles to my private roles takes a lot of psychological effort
Physical Magnitude of Transition (self-developed based on Ashforth et al. 2000)	
PHY01	When I am at home, it is hard for me to physically reach or gain access to business communication tools
PHY02	When I am at work, it is hard for me to physically reach or gain access to private communication tools
PHY03	Switching from my private roles to my business roles takes a lot of physical effort
PHY04	Switching from my business roles to my private roles takes a lot of physical effort
Work from Private Segmentation Preference (source: Kreiner 2006)	
WFP01	I don't like to have to think about work while I'm at home
WFP02	I prefer to keep work life at work
WFP03	I don't like work issues creeping into my home life
WFP04	I like to be able to leave work behind when I go home
Private from Work Segmentation Preference (source: Kreiner 2006)	
PFW01	I don't like to have to think about my family/personal life while I'm at work
PFW02	I prefer to keep my family/personal life at home
PFW03	I don't like family/personal life issues creeping into my work life
PFW04	I like to be able to leave my family/personal life behind when I go to work

Table A.1 (Continued)

Theoretically Unrelated Marker Questions for Control of CMV (source: self-developed)	
CMV01	I do not trust any classical and conventional medical therapies
CMV02	I want to be independent from classical and conventional medical therapies

[a] Respondents answered each item for five different devices: computer, laptop, tablet, smartphone, and landline telephone

[b] Respondents answered each item for nine different digital identities: landline telephone number, mobile telephone number, video telephony account, email address, instant messaging account, social network account, and filesharing account

[c] reverse-coded. Note: This item was dropped during validity testing

6.2 Appendix B. Further Results On the Formative Construct IIS Integration

Table B.1 Outer Weights and Loadings

	Outer Weight	*p*-value	Outer Loading	*p*-value
INT01 → IIS Integration	0.007	0.947	0.564	0.000
INT02 → IIS Integration	0.074	0.473	0.651	0.000
INT03 → IIS Integration	0.867	0.000	0.994	0.000
INT04 → IIS Integration	0.117	0.129	0.738	0.000

Table B.2 Indicator Correlations

	INT01	INT02	INT03	INT04
INT01	1.000	–	–	–
INT02	0.787	1.000	–	–
INT03	0.528	0.604	1.000	–
INT04	0.357	0.420	0.678	1.000

6.3 Appendix C. Further Results for the Evaluation of the Measurement Model

Table C.1 Descriptive Statistics, Main Factor Loadings, Internal Consistency, and Average Variance Extracted for Latent Control Variables

	No. of Items	Mean	SD	Loadings	CR	AVE
Work from Private Segmentation Preference	4	5.259	1.595	0.765–0.845	0.882	0.651
Private from Work Segmentation Preference	4	5.155	1.537	0.603–0.924	0.857	0.605

Table C.2 Loadings for Latent Variables (main loading in italics)

		IIS	BLU	INT	PSY	PHY	WFP	PFW
IIS Integration	INT01	*0.564*	0.435	0.373	0.425	0.429	–0.159	0.067
	INT02	*0.651*	0.451	0.417	0.484	0.561	–0.264	–0.064
	INT03	*0.994*	0.704	0.675	0.766	0.783	–0.095	0.043
	INT04	*0.738*	0.540	0.507	0.580	0.550	0.165	0.154
Domain Blurring	BLU01	0.679	*0.897*	0.760	0.806	0.727	–0.082	–0.007
	BLU02	0.558	*0.857*	0.523	0.576	0.480	–0.074	0.084
Cross-Domain Interruptions	INT01	0.584	0.665	*0.866*	0.632	0.629	–0.124	0.082
	INT02	0.587	0.616	*0.863*	0.636	0.552	0.056	0.208
Psychological Magnitude of Transition	PSY01	0.699	0.729	0.671	*0.903*	0.762	–0.065	–0.012
	PSY02	0.670	0.717	0.662	*0.890*	0.735	–0.068	0.060
	PSY03	0.689	0.683	0.623	*0.878*	0.782	–0.090	0.012
	PSY04	0.693	0.717	0.663	*0.901*	0.746	–0.050	0.087
Physical Magnitude of Transition	PHY01	0.664	0.568	0.554	0.654	*0.868*	–0.072	–0.004
	PHY02	0.669	0.608	0.617	0.727	*0.882*	–0.046	0.017
	PHY03	0.742	0.651	0.627	0.814	*0.910*	–0.093	0.028
	PHY04	0.727	0.658	0.635	0.817	*0.906*	–0.191	0.009
Work from Private Segmentation Preference	WFP01	–0.041	–0.077	0.029	–0.030	–0.058	*0.765*	0.439
	WFP02	–0.083	–0.066	–0.080	–0.039	–0.077	*0.774*	0.386
	WFP03	–0.073	–0.091	0.036	–0.080	–0.114	*0.841*	0.577
	WFP04	–0.067	–0.059	–0.094	–0.080	–0.105	*0.845*	0.371
Private from Work Segmentation Preference	PFW01	0.057	0.047	0.189	0.069	0.049	0.400	*0.924*
	PFW02	–0.001	0.011	0.023	–0.030	–0.029	0.467	*0.603*
	PFW03	–0.009	–0.027	0.108	–0.017	–0.065	0.553	*0.833*
	PFW04	0.068	0.063	0.082	0.015	0.008	0.512	*0.714*

Note: *IIS* IIS Integration, *BLU* Domain Blurring, *INT* Cross-Domain Interruptions, *PSY* Psychological Magnitude of Transition, *PHY* Physical Magnitude of Transition, *WFP* Work from Private Segmentation Preference, *PFW* Private from Work Segmentation Preference

Table C.3 Inter-Factor-Correlations (square root of AVE in the diagonal)

	IIS	BLU	INT	PSY	PHY	WFP	PFW
IIS Integration	–	–	–	–	–	–	–
Domain Blurring	0.709	0.877	–	–	–	–	–
Cross-Domain Interruptions	0.677	0.741	0.864	–	–	–	–
Psychological Magnitude of Transition	0.770	0.797	0.734	0.893	–	–	–
Physical Magnitude of Transition	0.787	0.698	0.683	0.847	0.892	–	–
Work from Private Segmentation Preference	–0.084	–0.089	–0.040	–0.077	–0.115	0.807	–
Private from Work Segmentation Preference	0.051	0.040	0.167	0.041	0.014	0.548	0.778

Note: *IIS* IIS Integration, *BLU* Domain Blurring, *INT* Cross-Domain Interruptions, *PSY* Psychological Magnitude of Transition, *PHY* Physical Magnitude of Transition, *WFP* Work from Private Segmentation Preference, *PFW* Private from Work Segmentation Preference

6.4 Appendix D

Table D.1 Structural Model Results for Control Variables

	Path Coefficient
Work from Private Segmentation Preference → Domain Blurring	–0.075
Work from Private Segmentation Preference → Cross-Domain Interruptions	–0.078
Work from Private Segmentation Preference → Physical Magnitude of Transition	–0.030
Work from Private Segmentation Preference → Psychological Magnitude of Transition	–0.005
Private from Work Segmentation Preference → Domain Blurring	0.050
Private from Work Segmentation Preference → Cross-Domain Interruptions	0.185 *
Private from Work Segmentation Preference → Physical Magnitude of Transition	–0.005
Private from Work Segmentation Preference → Psychological Magnitude of Transition	0.007
Weekly Working Hours → Domain Blurring	0.067
Weekly Working Hours → Cross-Domain Interruptions	–0.025
Weekly Working Hours → Physical Magnitude of Transition	0.024
Weekly Working Hours → Psychological Magnitude of Transition	0.025
Number of Children → Domain Blurring	0.017
Number of Children → Cross-Domain Interruptions	0.011
Number of Children → Physical Magnitude of Transition	–0.014
Number of Children → Psychological Magnitude of Transition	0.002
Number of Cohabitants → Domain Blurring	0.013
Number of Cohabitants → Cross-Domain Interruptions	0.140
Number of Cohabitants → Physical Magnitude of Transition	0.160 **
Number of Cohabitants → Psychological Magnitude of Transition	0.109

Table D.1 (Continued)

	Path Coefficient
Gender → Domain Blurring	0.003
Gender → Cross-Domain Interruptions	0.105 *
Gender → Physical Magnitude of Transition	0.019
Gender → Psychological Magnitude of Transition	0.004
Age → Domain Blurring	0.072
Age → Cross-Domain Interruptions	0.028
Age → Physical Magnitude of Transition	–0.065
Age → Psychological Magnitude of Transition	–0.053

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

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Conflict of interest J. Lanzl, L. Utz, P. Afflerbach and H. Gimpel declare that they have no competing interests.

Ethical standards For this article no studies with human participants or animals were performed by any of the authors. All studies mentioned were in accordance with the ethical standards indicated in each case. Informed consent to participate was obtained from all respondents in the empirical studies, compliance with GDPR was ensured.

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