WHICH PROCESSES DO USERS NOT WANT ONLINE? - EXTENDING PROCESS VIRTUALIZATION THEORY

Completed Research Paper

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Abstract

Following the advent of the Internet more and more processes are provided virtually, i.e., without physical interactions between involved people and objects. For instance, E-Commerce has virtualized shopping processes since products are bought without physical inspection and interaction with sales staff. This study is founded on the key idea of process virtualization theory (PVT) that from the users' perspective not all processes are equally amenable for virtualization. We investigate characteristics of processes, which are causing users' resistance toward the virtualized process.
Surveying 501 individuals regarding 10 processes, this study constitutes the first quantitative test evaluating the prediction capabilities of PVT by analysis of varying processes. Moreover, it introduces and successfully tests the extended PVT (EPVT), which integrates PVT with multiple, related constructs from extant literature in a unified model with multi-order causal relations. Thereby, it clearly enhances our understanding of human behavior with regard to the frequent phenomenon process virtualization.
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Keywords: Extended Process Virtualization Theory, Public Sector, Electronic Services

Introduction

As early as 1744, Benjamin Franklin invented the first mail order catalog in the USA (Maddox 1997, p. 45; Romaine 1990, p. 71). Customers were able to order and pay scientific books by mail, without any physical store visit. More than 250 years later, we live in an "increasingly virtual society" (Overby 2008, p. 277). Fostered by groundbreaking technological inventions, such as telephone networks and the Internet, more and more processes that used to be conducted in a physical manner are now virtualized (Overby 2008; Overby and Konsynski 2008). Particularly the fast diffusion of Internet technologies has accelerated this trend for virtualization of previously physically delivered processes, i.e., processes that were previously delivered face-to-face are now conducted via Internet. Overby defines a virtual process as "a process in which physical interaction between people and/or objects has been removed" (Overby 2008, p. 278).[1] In the private sector, for instance, E-Commerce has virtualized shopping processes by allowing customers to shop from their homes without meeting any sales personnel and without actually seeing or touching the goods they are buying. Moreover, online banking has transformed banking processes, which were previously conducted physically over the counter.

Virtualization of previously face-to-face conducted processes is nowadays not only a frequent phenomenon, but a very interesting field of study in the research area of interaction between people and information technology (IT). In essence, for users in a newly virtualized process the physical interaction is substituted either by IT-mediated interaction or by complete self-service. Typically the offered virtual alternative is not an exclusive option, but exists in addition to the face-to-face option and the people can pick their preferred alternative for the respective process (Overby 2008). For instance, customers can decide to either buy a book online or in a physical store. Overby argues not all processes are equally amenable for virtualization from the perspective of the involved individuals and initial research is supporting this hypothesis (Barth and Veit 2011). Therefore understanding the preference of individuals given a virtual and a face-to-face alternative for conduction of varying processes is promising field for research (Venkatesh 2006). This study investigates for which types of processes users value the typical benefits of virtualization, e.g. twenty-four-seven availability or conduction from home, and for which they are despite these benefits resistant to substitute physical interaction with humans or objects by IT. Results regarding this overarching research field of virtualization might influence research in domains like virtual teams, virtual worlds/communities, E-Business, etcetera.

This piece of research aims at thoroughly testing and extending the process virtualization theory (PVT) as suggested by Overby, which predicts the "virtualizability" of an investigated physical processes based on some of its process characteristics: To the best knowledge of the authors the PVT has not been quantitatively tested for multiple, varying processes, but has only been applied exemplarily for one single process (Overby and Konsynski 2008). Consequently and in accordance with the original author, the promising PVT requires quantitative analysis of multiple physical processes to be able to evaluate its prediction capabilities with regard to virtualizability of varying processes (Overby 2008, p. 289; Overby and Konsynski 2008, p. 30). Furthermore, in extant literature several related theoretical constructs have been identified, which have the potential to notably extend PVT (Barth and Veit 2011). This study strives for integration of PVT with these constructs in a unified model by employing multi-order causal relations. The resulting model should provide more concrete insights for practitioners and is quantitatively tested. Therefore, this study fruitfully parallels the approach applied by Venkatesh and Davis (2000), who suggested and tested determinants for the TAM construct 'perceived usefulness' to allow for meaningful interventions.

Theoretical Background

In this section first the PVT is introduced and compared to extant theory. Second, relevant previous research in the E-Government and E-Commerce literature is sketched, before finally the extensions to PVT are motivated and the hypothesis of this study formulated.

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1 In this context, in agreement with Overby (2008, p. 274), a process "is broadly defined as a set of steps to achieve an objective".

Process Virtualization Theory and a Comparison to Extant Theory

In its core, PVT states that "some processes are more amenable to virtualization than others" (Overby 2008, p. 277) and proposes that there are key characteristics which affect the 'virtualizability' of a process.

Overby analyzes the virtualizability of a process from the user's perspective, not the provider's, and defines the influence factors accordingly. Hence, in the sense of the process virtualization theory, a process more amenable to virtualization is or will be conducted frequently in a virtual manner by its target group, without significant resistance at the time the virtual process is realized. In contrast, the targeted individuals will not naturally perform a process online that is less amenable for virtualization.

Overby (2008, p. 280) introduces four factors which negatively affect the virtualizability of a process: 'Sensory requirements' are defined as "the need for process participants to be able to enjoy a full sensory experience of the process and the other process participants and objects. Sensory experiences include seeing, hearing, smelling, touching, and tasting [...] as well as the overall sensation that participants feel when engaging in a process, e.g. excitement" (Overby 2008, p. 280). For instance, if the participant likes to smell an object, e.g. perfume, within the process, this has a negative influence on its virtualizability.

The second construct, 'relationship requirements,' is defined as "the need for process participants to interact with one another in a social or professional context. Such interaction often leads to knowledge acquisition, trust development, and friendship development" (Overby 2008, p. 281). For example, if the participants of a process enjoy meeting each other, i.e., beyond the information-exchange necessary for the process itself, this has a negative influence on the virtualizability of this process.

'Synchronism requirements' are the third construct proposed to affect 'process virtualizability' negatively. Overby (2008, p. 281-282) defines it as "the degree to which the activities that make up a process need to occur quickly with minimal delay". Thus, if the participant of a process wants immediate results, e.g. direct handover of a physical product, this has a negative effect on the 'process virtualizability'.

'Identification and control requirements' are proposed as the fourth construct and defined as "the degree to which the process requires unique identification of process participants and the ability to exert control over/influence their behavior" (Overby 2008, p. 282). If a process requires the secure identification of the participants in a process, e.g. to make sure that the contractual provisions are fulfilled, this has a negative influence on 'process virtualizability'.

In his conceptual paper, Overby presents a new model, aggregating the results of multiple fragmented, but virtualization-related, research domains such as online banking or online shopping. His approach is complementary to related information systems or communication research theories. Technology acceptance and innovation diffusion theories, such as TAM or UTAUT (cf. Davis 1989; Venkatesh et al. 2003), investigate the acceptance of concrete implemented technologies or innovations. For instance, the TAM construct 'ease of use' clearly depends on the implementation e.g. of the user-interface. In contrast, process virtualization theory can be used earlier in the IT-artifact life-cycle, since it analyzes the process, which might be implemented with different products or technologies (Overby 2008). In comparison to media richness theory, PVT is more comprehensive for two reasons: First, it not only targets communication tasks between people, but all kinds of processes, including those involving physical objects. Second, it employs a broader range of process characteristics, beyond "equivocality" and "uncertainty of communication tasks" (cf. Daft et al. 1987, p. 357). PVT's key idea is similar to the one of task-technology fit theory (TTF, cf. Goodhue and Thompson 1995). In PVT the specific 'fit' between a process and the virtual delivery mode is investigated from the users' perspective. But in contrast to TTF, PVT aims at predicting the 'fit' based on selected process characteristics and is not simply assessing the fit by questioning the individuals how they evaluate it. Furthermore, PVT is related to the literature on user resistance to IT. In the sense of the PVT low 'process virtualizability' means high resistance in the targeted audience toward the virtualized process and vice versa. In literature, few publications "proposed theoretical explanations of how and why resistance occurs" (Lapointe and Rivard 2005, p. 462). These explanations are different to PVT and the purpose of this study since none of these address resistance toward a voluntary virtual alternative to the face-to-face mode. In contrast, these publications analyze resistance toward mandatory IT implementations within an organizational workplace setting (Joshi 1991; Kim and Kankanhalli 2009; Lapointe and Rivard 2005; Marakas and Hornik 1996; Markus 1983). In addition, these models differ by not involving any specific process or artifact characteristic but focusing on

personal, social or organizational factors such as (in-)equity status, position of power, threats, or colleague option. In essence, PVT provides the best starting point for investigation of the phenomenon of process virtualization and for practical prioritization of potentially to be virtualized processes. At the same time, it requires quantitative support and, to be applicable in practice, more concrete specification of its determinants, for instance by second-order predictors.

Related E-Government Research

Given the large number of public services and the small proportion that is conducted via e-services so far,[2] one might assume a great potential for virtualization of further services in this sector. International E-Government studies, however, have discovered a number of public e-service projects that proved unsuccessful (Carter and Weerakkody 2008; Chan et al. 2010; Jaeger 2003). These authors argue that this trend is common even today. One of the main reasons for this is citizens' reluctance to use the provided e-services; another is the lack in citizens' awareness of the electronic offering. Increasing awareness of this challenge has influenced E-Government research: While it previously focused on the provision of electronic services (i.e., the supply-side), the emphasis is now shifting to the demand side.

Factors influencing the use of existing public e-services have been researched on the basis of established technology acceptance or innovation diffusion models (e.g. Carter and Bélanger 2005; Chan et al. 2010). In addition, in particular trust and perceived risk related constructs have been used to extend this theoretical foundation (e.g. Bélanger and Carter 2008; Hung et al. 2006). Beyond technology acceptance, trust and risk, few really different theoretical foundations have been used to empirically investigate public e-services: Connolly et al. (2010) evaluate the e-service quality of existing public e-services and Thomas and Streib (2003) leverage citizen-initiated contact theory from traditional public administration literature for e-services. In summary, neither PVT nor other, comparable theoretical models have been applied for the investigation of public process virtualization. The extant models do not analyze process characteristics. They focus on later stages of the IT-artifact life-cycle, i.e., concretely implemented e-services, rather than on face-to-face delivered processes, which might be virtualized in future. Notable exceptions are studies that transferred and generalized media richness propositions (cf. Daft et al. 1987) to the public sector to analyze public e-service. These authors found process or task complexity and ambiguity as relevant process specific characteristics influencing the resistance regarding the respective e-service (e.g. Ebbers et al. 2008; Pieterson and van Dijk 2007). Also, some perceived risk related constructs seem interesting for process virtualization, if appropriately transferred to the analyzed object, namely a specific process.

Related E-Commerce Research

Factors influencing the use of online shopping have been analyzed in the E-Commerce literature (Chang et al. 2005). The influence factors for E-Commerce usage by individuals can be classified into (a) consumer characteristics, (b) channel characteristics, (c) website or application characteristics, (d) provider/organizational characteristics, (e) situational factors, and (f) product/service characteristics (Black et al. 2002, p. 171; Chang et al. 2005, p. 545; Monsuwe et al. 2004, p. 105). As this study investigates the influence of process characteristics the latter class is most relevant. Product and service characteristics that are found influential on E-Commerce usage in literature can be broadly grouped into three groups: 'importance of product/service', 'ability to judge the quality of the product/service', and 'perceived product/service risk'.

With regard to 'importance', product and services associated with high 'consumer involvement' are less amenable to online shopping than products and services without these attributes (Black et al. 2002; Mayo et al. 2006). While the same was hypothesized to be true for 'costly and less frequently consumed products/services' in multiple studies, the empirical results are ambiguous: Phau and Poon (2000) found empirical evidence for this relation, but Vijayasarathy (2002) was not able to show such an influence.

[2] In the project "BundOnline 2005", more than 500 public services were investigated on the federal level alone (BMI 2006).

Second, the 'ability to judge the quality of the product/service' affects its suitability for the online channel (De Figueiredo 2000). 'Tangible products' (Hassanein and Head 2004; Phau and Poon 2000; Vijayasarathy 2002) as well as products and services with high 'complexity' (Black et al. 2002; Järveläinen 2007) and/or 'inspection desire' (Fenech and O'Cass 2001) on the part of the user are less amenable to online shopping. With respect to tangibility, for example, Phau and Poon (2000, p. 103) argue: "One weakness of the Internet is that it can realistically reproduce only two of our five senses, namely, sight and sound. One cannot feel, smell or taste products that are advertised on the WWW. This limitation will restrict the kind of products that are sellable on the Internet." The empirical results for 'standardized products and services,' i.e., with low differentiation, are contradicting: Even though Elliot and Fowell (2000) identified a positive effect for 'standardized products and services' on amenability to online shopping, Phau and Poon (2000) found the inverse influence.

'Perceived product/service risk' constitutes another definite factor emphasized in three studies (Bhatnagar et al. 2000; Black et al. 2002; Lowengart and Tractinsky 2001). It "is associated with the product itself" (Bhatnagar et al. 2000, p. 99) and differs to risks related to the sales channel or the implementation of the website. Products and services with higher perceived risk are less amenable to E-Commerce.

In summary, within the E-Commerce literature the factors identified in the groups 'importance of the product/service' as well as 'product service risk' seems most interesting for the extension of the PVT, since the 'ability to judge the quality of the product/service' is already captured in its construct 'sensory requirement'.

Hypotheses of Extended Process Virtualization Theory (EPVT)

The theoretical model in this study amplifies the PVT by three substantial extensions as suggested in the qualitative study by Barth and Veit (2011). First, following the recommendations in the E-Government literature, it adds 'process complexity', 'process ambiguity', and 'need for consultation' as process characteristics influencing the acceptance negatively. Second, the PVT construct 'identification and control requirements', which was not supported in the first quantitative test (Overby and Konsynski 2008), is replaced by two constructs representing the process related perceived risk facets, namely 'performance risk' 'privacy and security risk' (cf. Featherman and Pavlou 2003), as perceived risk was detected influential in E-Government and E-Commerce research (see above). Both risk facets are proposed to lead toward resistance for the respective e-service. Third, leveraging the E-Commerce literature review, 'process involvement' is included as latent variable leading to citizens' resistance regarding the e-service. Furthermore, in accordance with Barth and Veit, the dependent variable is 'reversed', i.e., changed form "virtualizability" in PVT to "citizens' resistance" in EPVT as all included variables are proposed to lead to resistance toward the respective e-service.

While the qualitative study provides initial support for the influence of these process characteristics on the dependent variable, in particular for 'process involvement', 'sensory requirements' and 'synchronism requirements', a quantitative test of the model investigating a large number of processes with very different characteristics seems necessary to confirm its predictive value for varying processes. Moreover, the causal structure of the proposed process characteristics, i.e., potential multi-order causal relations between these factors themselves, requires further investigation and statistical analysis provides fruitful means for this purpose. Consequently, the following hypotheses are formulated for this large-scale quantitative study, proposing multi-order causal relations (see Figure 1).

H1: The greater the *perceived sensory requirements* of a process, the higher is the users' resistance toward conducting this process virtually.

H2: The greater the *perceived relationship requirements* of a process, the higher is the users' resistance toward conducting this process virtually.

H3: The greater the *perceived synchronism requirements* of a process, the higher is the users' resistance toward conducting this process virtually.

Sensory requirements are defined as "the need for process participants to be able to enjoy a full sensory experience of the process and the other process participants and objects. Sensory experience include

seeing, hearing, smelling, touching, and tasting" (Overby 2008, p. 280). *Relationship requirements* are defined as "the need for process participants to interact with one another in a social or professional context. Such interaction often leads to knowledge acquisition, trust development, and friendship development" (Overby 2008, p. 281). *Synchronism requirements* are defined as "the degree to which the activities that make up a process need to occur quickly with minimal delay" (Overby 2008, p. 281-282).

H4: The greater the *perceived performance risk* of a process, the higher is the users' resistance toward conducting this process virtually.

H5: The greater the *perceived privacy and security risk* of a process, the higher is the users' resistance toward conducting this process virtually.

Perceived performance risk "refers to the possibility that the [... process/service] will not function as expected and/or will not provide the desired benefit" (Grewal et al. 1994, p. 145). *Perceived privacy and security risk* is defined as the "potential loss of control over personal information, such as when information about you is used without your knowledge or permission. The extreme case is where a consumer is 'spoofed' meaning a criminal uses their identity to perform fraudulent transactions" (Featherman and Pavlou 2003, p. 455).

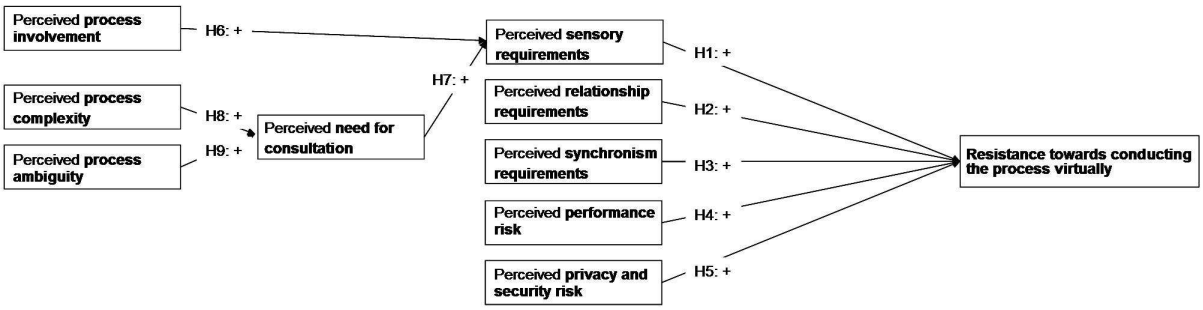

Figure 1. Research Model "EPVT"

The following two hypotheses are adapted with regard to the suggestions of Barth and Veit. In their theoretical model, 'perceived sensory requirements' and 'perceived process involvement' are separated constructs, since the two variables represent different aspects. For instance, processes with involved physical goods could have high 'perceived sensory requirements' as users value physical investigations, even though no 'process involvement' for this process might be given. In contrast, Overby (2008, p. 280) subsumed both an individual's willingness to use his or her senses and "the overall sensation that participants feel when engaging in the process" in the one variable 'sensory requirements'. This variable can be interpreted as having a similar meaning as the 'process involvement' construct. In the qualitative study, both variables are identified as main determinants of the dependent variable users' resistance. But on the basis of the qualitative data, no meaningful statement can be provided regarding the potential second-order interrelation of the two variables, e.g. if one mediates the influence of the other on the endogenous variable. In contrast, this quantitative study allows to interpret correlations and to meaningfully test more complex theoretical models, including multi-order structural models (Chin 1998a). Therefore, a causal relation of the two variables is hypothesized for this study, based on theoretical considerations and tested to further improve the theoretical model. While the two variables are still defined and measured separately, 'process involvement' is hypothesized to have an indirect, i.e., fully mediated, effect on the dependent variable by exercising a direct influence on 'sensory requirements'. This adjustment takes into account that, in accordance with Overby (2008, p. 280), 'sensory requirements' is the more general concept and might be higher for high involvement processes.

H6: The greater the *perceived process involvement* of a process, the higher are the users' *perceived sensory requirements* (i.e., effect of 'process involvement' on 'resistance' fully mediated).

Perceived process involvement is defined as "a person's perceived relevance of the [... process] based on inherent needs, values, and interests" (Zaichkowsky 1985, p. 342). This hypothesis appears reasonable, since for services with high involvement a full sensory perception seems desirable.

Similarly, a high 'need for consultation' might not have a direct effect on the dependent variable users' resistance, but it makes users request a richer sensory spectrum, to be able to perceive and evaluate many pieces of information as quickly and as reliably as possible.

H7: The greater the *perceived need for consultation* of a process, the higher are the users' *perceived sensory requirements* (i.e., effect of 'need for consultation' on 'resistance' fully mediated).

Kimball (1997, p. 4) reports a very similar customer behavior within the financial industry as the result of an increased variety of products, services, and channels: "The result has been the rise of specialized brokers/agents, integrators, and facilitators to assist consumers with transaction that are perceived either as too technical, [...] or too difficult to be made unaided. These broker/agents, integrators, and facilitators can be human or automated". This last aspect is also of high importance for other e-services. While the author suggests that *need for consultation* influences 'users' resistance toward conducting the process virtually', i.e., the dependent variable, this does not have to be the case. The need for consultation could also be met by an automatic agent, in the simplest case by provision of appropriate frequently asked questions.

H8: The greater the *perceived process complexity* of a process, the higher is the *perceived need for consultation* (i.e., effect of 'process complexity' on 'sensory requirements' fully mediated).

H9: The greater the *perceived process ambiguity* of a process, the higher is the *perceived* n*eed for consultation* (i.e., effect of 'process ambiguity' on 'sensory requirements' fully mediated).

Process "complexity is about the number of interrelated actions a citizen has to take in order to solve one's problem. The more interrelated actions the more complex a [... process] becomes. The higher [... process] complexity becomes, the more information an individual has to process in order [...]" to conduct the process correctly (Ebbers et al. 2008, p. 194-195). *Process "ambiguity* is about not feeling sure of how to interpret information telling what to do. To remove or reduce problem ambiguity government needs to confirm whether or not a citizen's interpretation is correct" (Ebbers et al. 2008, p. 194).

Research Method

Selection of Investigated Processes

As shown in Table 1, ten German public processes have been selected for investigation. The processes are selected based on the existing classification schemes for public services to cover a wide range of public processes with varying characteristics.

In summary, all public processes selected, would belong to the E-Government sub-domain E-Administration, if provided online (cf. Veit 2008). The processes are provided by public institutions and targeted for citizens. Thus, the processes can be considered Government-to-Citizen (G2C) services (cf. von Lucke and Reinermann 2000, p. 2). Services provided for other target groups (e.g. businesses or non-profit organizations) might require an adapted model due to different goal and decision structures in organizations. None of the ten public processes are yet electronically delivered, or at least not to a considerable extent. Each of the ten services represents one life-event (e.g. "family & partnership") in the life-event framework (cf. Leben and Vintar 2003) used by the German federal state of Brandenburg (2010) to structure their (online and offline) service offerings on their website. To represent the German public sector landscape as accurately as possible, services provided by each of the three federal levels of the public sector, namely federal government, federal states, and municipalities (Maurer 2009, p. 571), were chosen. Furthermore, the selection focuses on transactional and more communicative services (cf. Bélanger and Hiller 2006).

Table 1. Selected Public Processes for Investigation, Life-Events Based on Brandenburg (2010)			
Public process	Life-event	Service provider	Type of service
1 Conduct a civil marriage	Family & partnership	Municipality	Transactional
2 Register (a new address) with the personal registration system	Administration & organization	Municipality	Transactional
3 Cancel a church registration	Culture, sport and leisure	Municipality	Transactional
4 Register a vehicle	Traveling & transportation	Municipality	Transactional
5 Apply for unemployment benefits	Employment & economy	Federation	Transactional
6 Register children for a school	Study & education	Federal state	Transactional
7 Seek advice regarding social Pensions	Health & social benefits	Federation/ Federal state	Communicational
8 Seek advice regarding a house building permit	Building & habitation	Municipality	Communicational
9 Seek advice regarding waste Disposal	Environment & consumer protection	Municipality	Communicational
10 Seek advice in crime prevention panels	Order & security	Federal state	Communicational

Pre-Study for Instrument Development

The complete measurement scale was developed and confirmed by a prior scale development study based on the recommendations of Moore and Benbasat (1991) as well as DeVellis (2003). This pre-study included three rounds of qualitative evaluation (overall 62 interviews with citizens and experts) and one quantitative pre-test (with more than 210 surveyed citizens). Following standard psychometric procedures, four measurement items were generated for each of the seven reflectively measured constructs and one item was used for each dimension of the three formatively measured constructs. For all variables, except for some of the control variables such as age or gender, a seven point Likert scale was used. As discussed above, the process virtualization theory is comparably new and has – to the best knowledge of the authors – only been quantitatively tested once. For this reason, no established measurement instrument exists: In the original publication (Overby 2008), the theory is only discussed along a historic case, and thus no measurement scale is provided. Overby and Konsynski (2008) apply the process virtualization theory to the wholesale automotive market and analyze quantitative data from this field. But Overby and Konsynski only investigate one process, namely that of buying used cars for resale to end customers, which can be conducted either physically or by use of online platforms. The measurement scales used in their study are very specific to this process and domain. For this reason, the measurement scales of Overby and Konsynski for 'sensory requirements,' 'relationship requirements,' and 'synchronism requirements' are adapted to be addressable to different kinds of public processes. Also, for the newly added constructs in the extended PVT no ready-to-use instruments could be found due to the new context: First, the existing items had to be adjusted to be applicable to processes (as opposed to products or tasks). Second, the instruments had to be modified to be usable with ten different processes. Third, the items had to be adapted to the public domain. Nevertheless, established measurement instruments were taken from literature as basis and adjusted to the context wherever possible. The complete list of resulting items and the used references are depicted in the appendix of this paper. Based on the recommendation of Petter et al. (2007), Jarvis et al. (2003), and Diamantopoulos and Winklhofer (2001), three of the constructs are measured formatively, namely 'sensory requirements', 'synchronism requirements', and 'privacy and security risk'.

Data Collection Approach and Sample Characteristics

For each selected process, a separate survey version was generated based on the same items. The versions only differ in a few words per item, due to the required adaptation to the process at hand and the institution providing this service (e.g. different name of the service or different name of the service provider). The complete item instrument is depicted in the appendix.

Table 2. Socio-Demographics of Sample, Based on TNS-Infratest (2010) and Statistisches Bundesamt (2010a)

Dimen-Sion	Subgroup	Distribution of …		
		Of German Internet users	Of sample	Range per process
Age [in years]	16-29	26%	27%	20-32%
	30-49	42%	42%	38-47%
	>49	32%	31%	28-34%
Gender	Male	54%	53%	45-59%
	Female	46%	47%	42-55%
Education Level	No graduation	5%	4%	2-4%
	Certificate of secondary education	34%	33%	29-36%
	General certificate of secondary education/ professional	30%	30%	28-38%
	University-entrance diploma/ university degree	31%	33%	28-37%

The survey was conducted during a period of two weeks in November 2010. In order to reach a representative sample, an e-mail invitation was sent to members of a nationwide panel of German Internet users (cf. Son and Kim 2008, p. 514). The participants were awarded a small allowance in exchange for their time. While at the first glance this data collection approach seems delicate for surveys addressing e-service adoption, it represents a well-suited procedure for the concrete research questions at hand: Obviously by use of an online access panel only Internet users can be surveyed, and exactly these form the target group for this study. Naturally, German citizens without Internet access or without the right skills to use it will prefer traditional service delivery methods. The interesting question of how these people can be included into the digital society is already addressed by the digital divide literature (e.g. Becker et al. 2008; Wei et al. 2010). Therefore, this study explicitly excludes the digital divide bias and focuses on the resistance toward virtualized processes among citizens capable of using the respective services. A total of 660 participants completed the survey. On average, it took each of these citizen 14 minutes to answer all of the questions. Each citizen was only surveyed once and with respect to only one of the ten selected services. To include only those participants who invested enough time to read and answer all survey questions reasonably, participants who invested less than half of the average survey duration were excluded. From the remaining 525 answers, 24 were eliminated either due to missing values or because data runs indicated unreliable responses (i.e., answers exhibiting certain unlikely patterns, such as all maximum value or alternating between two values), yielding 501 answers for analysis (see Bulgurcu et al. 2010, p. 538, for similar approach and quotas).

Table 2 shows the distribution of the analyzed survey participants along the socio-demographic dimensions age, gender, and educational level for the complete sample, as well as the respective ranges for the subsamples regarding the ten processes (all citizens surveyed about the respective process). As presented in the table, the distribution is very similar to the socio-demographic distribution of German Internet users according to the latest reports of the Federal Statistical Office (Statistisches Bundesamt 2010a) and the German Internet initiative "D21"/TNS-Infratest (2010, p. 10) and thus can be seen as almost representative for German Internet users. The participants are distributed nearly equally across the 10 processes, with the number of participants surveyed per process ranging from 45 to 54.

Data Analysis and Results

Based on the software tool SmartPLS Version 2.0.M3 (Ringle et al. 2005), Partial Least Squares (PLS) analysis was used to ascertain the measurement and structural properties of the research model.[3] As commonly recommended in literature, the evaluation of the structural equation model consists of two steps (Anderson and Gerbing 1988; Chin 2010; Götz et al. 2010): (i) the evaluation of the measurement model, and (ii) the evaluation of the structural model.

Measurement Model Validation

Following the widely accepted recommendations of Bagozzi and Phillips (1982) the additional test of the measurement model on this studies sample (with N=501) includes the evaluation of convergent validity and discriminant validity for all reflective measured constructs. Regarding convergent validity, at the individual item level "indicator reliability" as well as at the construct level "construct reliability" has to be assessed (Homburg and Baumgartner 1995). Indicator reliability was tested for all items of reflective instruments based on the factor loadings. All items satisfied the commonly required quality criteria, namely factor loadings larger than 0.7 and statistical significance on the $p<0.05$ level (Homburg and Giering 1996, p. 12). Construct reliability of latent constructs was evaluated via standard estimates of Cronbach's alpha, composite reliability and the Average Variance Extracted (AVE). All values range comfortably above the prescribed thresholds (Homburg and Giering 1996, p. 12; Nunnally 1978, p. 245), thus supporting convergent validity (see Table 3). To assess discriminant validity, the square root of the AVE for each construct was compared against its correlations with any other construct. For the criterion of discriminant validity to hold, the square root of the AVE for each construct must be greater than its correlation with any other construct, which is the case for all constructs as shown in Table 3 (Fornell and Larcker 1981, p. 46; Hulland 1999, p. 199).

Table 3. AVE, Cronbach α, CR and Inter-Construct Correlation Matrix, Square Root of AVE shown in bold

Reflective constructs	AVE [>0.5]	Cron-bach α [>0.7]	CR [>0.7]	R	RR	PR	PI	NC	PC	PA
Resistance (R)	0.75	0.89	0.99	**0.86**						
Relationship requirements (RR)	0.77	0.90	0.93	0.76	**0.88**					
Performance risk (PR)	0.90	0.96	0.97	0.63	0.56	**0.95**				
Process involvement (PI)	0.76	0.90	0.93	0.55	0.65	0.45	**0.87**			
Need for consultation (NC)	0.76	0.90	0.93	0.42	0.50	0.43	0.49	**0.87**		
Process complexity (PC)	0.66	0.83	0.89	0.36	0.46	0.46	0.50	0.78	**0.81**	
Process ambiguity (PA)	0.74	0.89	0.92	0.32	0.38	0.43	0.37	0.69	0.74	**0.86**

While the items of reflectively measured constructs should be highly correlated, no recommendation regarding the correlation of items of formatively captured constructs can be given (Bollen and Lennox 1991; Chin 1998a). Consequently, as requested in literature (Götz et al. 2010; Krafft et al. 2005) the

[3] For the PLS algorithms and bootstrapping (cf. Chin 1998b, p. 320) the following standard properties were applied: maximum iterations: 300; path weighting scheme; case-wise replacement for missing values; no sign changes; cases: 500; samples: 500.

significance of the outer weights, not the factor loadings, was evaluated and confirmed for all formative items, with the only exception of the item PSR2. In accordance with the perception suggested by Cenfetelli and Bassellier (2009, p. 698), PSR2 is interpreted as absolutely important (i.e., due to the highly significant factor loading), but not relative (i.e., in comparison with the weight of the other indicator). Since it represents an important different facet of the formative measured variable, no theoretical overlap exists and the indicator is kept in the measurement model. Furthermore, formative items should be tested for multi-collinearity, since higher VIF values are seen as a signal to check for conceptual overlap between the involved formative indicators (Cenfetelli and Bassellier 2009, p. 693; Chin 1998b). Therefore, for the three formative constructs the variance inflation factor was calculated as an indicator for multi-collinearity (Götz et al. 2010). As shown in Table 4 all values range far below the commonly requested threshold of 10 (Diamantopoulos and Winklhofer 2001; Hair et al. 2006, p. 230) and even rank below the even stricter upper bound of 3.3 suggested by Petter et al. (2007, p. 641).

Table 4. Tolerance and Variance Inflaction Factor for all Formative Constructs

Formative constructs	Tolerance	Variance inflation factor (VIF) [<10 or even <3.3]
Sensory requirements (SR)	0.331	3.021
Synchronism requirements (SCR)	0.719	1.391
Privacy and security risk (PSR)	0.760	1.316

Structural Model Validation

To evaluate statistical significance, the bootstrapping routine of SmartPLS was used to calculate the t-values. Results from the PLS analysis of the structural model for hypotheses H1 to H9, including path coefficients and their statistical significance, are illustrated in Figure 2.

Six paths were found to be statistically significant on the p<0.001 level: 'sensory requirements,' 'performance risk,' 'process involvement,' 'need for consultation,' 'process complexity' and 'process ambiguity'. Significant paths were also identified for 'relationship requirements' (p<0.01) and 'synchronism requirements' (p<0.05). Only the influence of 'privacy and security risk' was not detected to be significant. Consequently, all formulated hypothesis, but H5 are supported.

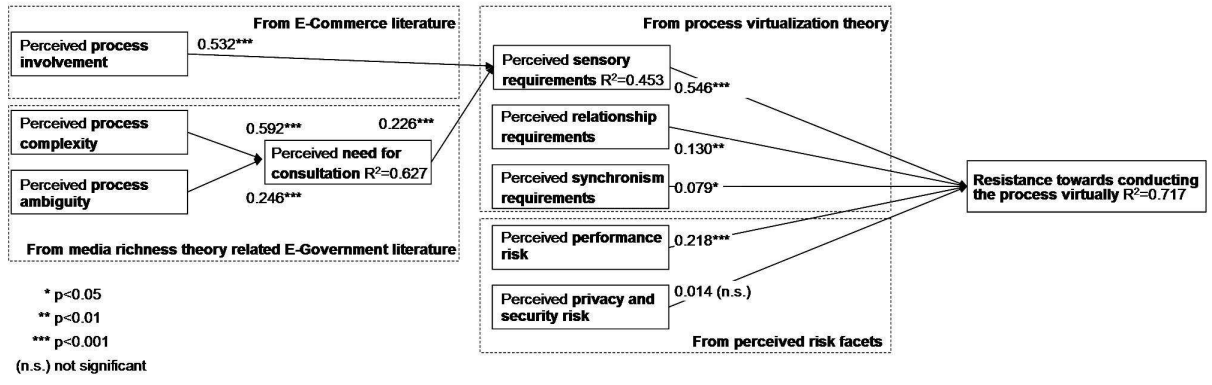

Figure 2. Statistical Results of PLS-Analysis of Research Model "EPVT"

The overall theoretical model is able to explain 72 percent of the dependent variable 'resistance toward conducting the process virtually'. This value comfortably exceeds 40 percent, the prescribed threshold for the *explained variance* R^2 of dependent variables as recommended by Homburg and Baumgartner (1995, p. 364). Moreover, the identified relations explicate 45 percent of the variance of the strongest influence factor 'sensory requirements' and 63 percent of 'need for consultation'. In addition, closely following the recommendations of Chin (1998b, p. 318), the SmartPLS blindfolding procedure with a common omission distance of 7 provided a Stone-Geisser criterion of Q^2=0.53, ranging well above the required threshold of

0 and hence yielding further confidence into the validity of the structural model (Chin 1998b; Fornell and Cha 1994, p. 73).

In the theoretical model of this study, four mediated causal relations are proposed and all four are hypothesized to be fully mediated relations (see H6-H9). Therefore, these hypotheses are explicitly tested using the statistical approach for mediation described by Hair et al. (2006, p. 866-868) and originally introduced by Baron and Kenny (1986, p. 1177). This approach consists of four steps, which are conducted sequentially with separate models and is able to explicitly test for fully mediated relations as opposed to only partially mediated ones. All respective hypotheses are supported, since full mediation is detected for all mediated relations.

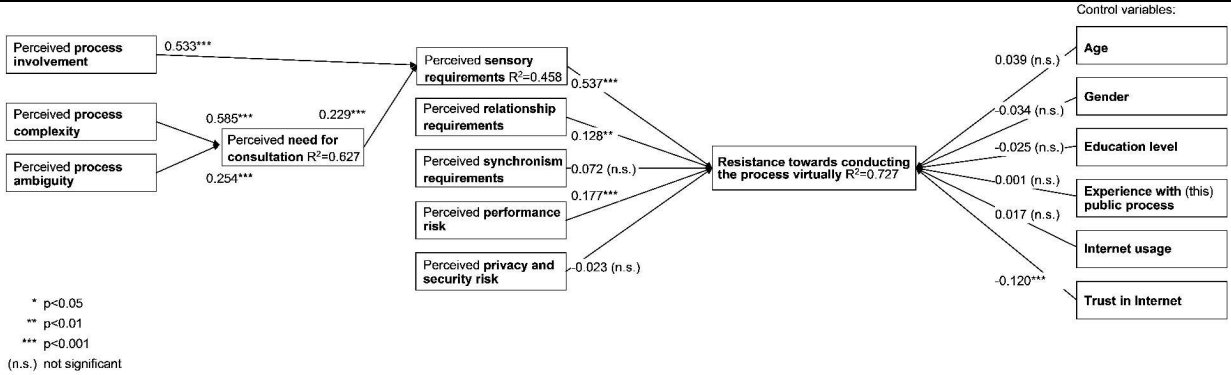

Figure 3. Statistical Results of PLS-Analysis of Research Model complemented with Control Variables

In order to check if other underlying effects not covered in the model cause the supported relations in the research model, the model is extended by a set of *control variables* and retested (see Figure 3). The control variables cover a wide range of relevant *users' characteristics*. They include socio-demographic properties, namely 'age', 'gender' and 'education level' of the survey participant, previous 'experience with the respective process' and channel-related characteristics of the survey participant, such as 'Internet usage' and 'trust in Internet'. In sum, these control variables test if characteristics of the participants rather than perceived characteristics of the process determine the dependent variable 'resistance'. As shown in Figure 3, no path of the control variables to the dependent variable is significant – with the exception of 'trust in Internet'. Thus, no significant influence on the dependent variable by the participants' age, gender, education level, process experience, or Internet usage is found. The effect of 'trust in Internet' is no surprise, since it could be expected that the 'resistance to use the virtualized process' is negatively influenced by the trust in the employed channel for virtualization, i.e., the Internet. Nevertheless, 'trust in the Internet' is not included in the original research model, since it is a characteristic of the citizen rather than a process characteristic. Interestingly, the path coefficients and their significance in the extended research model, which controls for the effect of 'trust in the Internet', are very similar to the ones in the original research model (see Figure 2). In comparison to the original model, in the extended model only the previously significant path from 'synchronism requirements' to 'resistance' switched non-significant, which change might be caused by the massive increase in the number of constructs in the extended model. No other significant change between the two models can be detected. This stresses the quality of the identified findings.

Discussion

Limitation and Future Research

Although this work presents the results of a thoroughly crafted, large-scale quantitative study, a number of limitations have to be considered. Since the study is based on a survey of German citizens, the authors cannot claim that the results are directly applicable to other nations and domains. But since in many

nations and domains across the world the same question is relevant, namely how to prioritize 'the right' services for virtualization, the authors suggest a thoughtful transfer.

Another limitation of this study is that it focuses on the perspective of the citizens, i.e., the 'customers' of the public services. Obviously, this point of view is not identical to the perspectives of the service providers. While public service providers should definitely focus on citizen-orientation (as discussed above), they need to consider further aspects for optimal decision-making, such as legal and technological requirements and overall financial analysis.

With regard to sample composition, three things have to be kept in mind. First, the survey was conducted among Internet users only and therefore can not explain aspects related to the digital divide. This means citizens without Internet access ("digital access divide") or elderly people without the required skills, so-called "digital capability divide" are not covered by this research (Becker et al. 2008; cf. Wei et al. 2010, p. 3).This approach was taken on purpose, since the study investigates users' resistance caused by process characteristics. Therefore, citizens without Internet access or the required skills would have biased the results. Second, the sample consists of citizens who, at the time of the survey, were not necessarily in a situation where they had to conduct the public service they were questioned on. The study controlled for this effect by considering the control variable 'process experience'. Third, as with all self-reported and intention-related data, common method variance and potential differences in the reported intention and future usage need to be considered. To control for common method variance, the approach recommended by Podsakoff et al. (2003) and Liang et al. (2007) was successfully employed. Given the lack of usage data for advanced virtualized public services, the study could not specifically evaluate the relationship between users' resistance and usage, but had to rely on respective theoretical literature (e.g. Ajzen 1991). Consequently, the authors encourage future research investigating e-service usage data based on the suggested model.

Since this study provides the first quantitative test of the EPVT and the first PVT-based findings in the public sector, the theoretical model requires further empirical confirmation. Besides the need to conduct similar studies in other nations, further replication studies are encouraged in other domains for further support regarding the generalizability to varying processes.

Theoretical Contributions

The results described above provide two major theoretical contributions. First, the study represents an important test of the main determinants of the PVT, which so far had only been quantitatively confirmed experimentally for a single process by the original author (Overby and Konsynski 2008). Interestingly, the results of this study are very consistent with the outcomes outlined by Overby and Konsynski. Their three significant path determinants 'sensory requirements,' 'relationship requirements,' and 'synchronism requirements' are also supported in this study. Moreover, with regard to generalization this study advances the current state of PVT in two critical aspects: It is the first study that employs the PVT in the public sector, thus demonstrating the PVT's transferability to this field and laying the foundation for further examinations in this particularly promising application area. The second aspect is equally important: This study differs from the previous work of Overby and Konsynski by investigating a set of ten different processes, instead of focusing on a single one. Thus, it is the first quantitative study that analyzes differences in 'resistance' for varying processes on the basis of process characteristics as suggested by PVT. Overby and Konsynski (2008, p. 30) encourage studies covering "two or more processes"; and this request was more than satisfied with the coverage of even ten processes in this work. In addition, the measurement scales were generalized to meet the requirements of the different processes investigated and thus provide a fruitful foundation for the investigation of further processes from various domains.

Second, this study does pioneers work by formulating and confirming the extended PVT (EPVT). The EPVT augments the original PVT with highly relevant constructs coming from related but not yet incorporated theoretical arenas, such as 'perceived risk facets', 'process involvement' as well as 'need for consultation', 'process complexity' and 'process ambiguity' (see Figure 2). These extensions are inspired by risk literature, E-Commerce research and applications of media richness theory in the public sector (Barth and Veit 2011). The resulting EPVT is able to explain 72 percent of the variance of users' 'resistance toward conducting a (particular) process virtually' by it determinants. One major achievement with regard to this contribution lies in the statistical confirmation of the hypothesized complex causal structure (see

hypotheses H6-H9). This profoundly integrates the parsimonious, traditional PVT with the additional constructs suggested in extant literature. The supported second-order structure is particularly meaningful because it sheds light on the predictors of the determinant 'sensory requirements', which is found to be the factor with the single most influence on users' resistance (cf. Cohen 1988, p. 410-413). Viewed in this vein, this study fruitfully parallels the approach applied by Venkatesh and Davis (2000), who suggested and tested determinants for the very general TAM construct 'perceived usefulness' to allow for meaningful interventions. One further contributions emerge from the findings outlined above and should not be overlooked. The newly added 'performance risk' determinant is not only clearly supported, but is found to be a strong predictor of 'resistance'. More specifically, it even holds the second largest effect size of all direct paths in the model.

Practical Implications

In view of the main objectives of e-services, namely to improve service quality and to reduce costs, e-services in particular need to achieve high usage rates in order to be successful. In fact, only with high usage rates significant cost savings can be realized that justify the required investments. Furthermore, only with high usage rates a larger number of users can benefit from improved service quality. Thus, a user-oriented selection of services for virtualization is mission critical, also in the public sector (Verdegem and Verleye 2009). While considerations of technology, cost, and legal constraints as well as the question of the optimal implementation must not be neglected in practice either, a user-oriented selection clearly emerges as a mandatory requirement for the success of an e-service.

The developed theoretical model importantly provides an analytical framework for practitioners who are considering a migration of their processes from physical to virtual delivery (cf. Overby 2008). For instance, the public sector is affected by high debts on all administrative levels in Germany, and in many other nations (OECD 2010; Statistisches Bundesamt 2010b). Therefore, migration to less human intensive and therefore lower-cost delivery options (cf. Venkatesh 2006) appears as a valuable chance not only in this sector. It is important to note, however, that cost savings can not be achieved automatically, without careful analysis, by virtualization of any randomly selected process. In fact, the virtualization of a service previously delivered face-to-face costs money first, e.g. to implement the solution, and the savings can only be realized later on by high usage rates of the virtualized service option. Not all processes are equally amenable to virtualization, since users perceive a varying degree of 'resistance toward conducting the respective virtualized processes'. Consequently, the well-considered, user-oriented selection and prioritization of virtualization effort is highly critical for successful service delivery and will become even more important in the future, due to increasingly complex e-services. Given the limited experience with virtualization and the dearth of profound guidance for prioritization of (public) processes, this work is of great practical relevance for service professionals. More specifically, practitioners can use the theoretical model to assess users' 'resistance' for the varying processes that are under evaluation, by consideration of their respective 'sensory requirements', 'relationship requirements', 'synchronism requirements', and 'performance risk' as elaborated on in the following paragraphs. If this evaluation results in high requirements, the process might still be virtualized, but requires far more effort by the practitioners to be successful (Overby 2008). In such a case, service providers should consider prioritizing other services or should explicitly address salient requirements during implementation and diffusion, as these indicate critical areas. The findings reveal 'sensory requirements' as the determinant with the largest effect size. Consequently, processes involving high sensory experience are harder to virtualize. To further substantiate this evaluation, the second-order structure predicting 'sensory requirements' proves helpful. High-involvement processes, such as conducting a marriage or registering kids at a school, as well as processes with high 'needs for consultation', e.g. seeking advice regarding a building permit, are likely candidates for high 'sensory requirements'. In decreasing effect size (cf. Cohen 1988, p. 410-413), 'performance risk', 'relation requirements' and 'synchronism requirements' are significant predictors of 'resistance' and should be evaluated during process prioritization.

This analysis allows for qualitative comparisons of public processes. High requirements in one field do not automatically disqualify a process from further evaluation; all dimensions have to be considered. Furthermore, it is important to note that evaluation results for one process can not thoughtlessly be transferred to other processes, not even to the delivery of a similar service in another nation. Rather, the discrepancies of the concrete services and the differences in the respective physical process delivery have

to be taken into account, as these provide the foundation for the perception of the respective users. Accordingly, business process reengineering (BPR), which might change virtual process with regard to the original physical process (cf. Kettinger et al. 1997), can be initiated based on the outlined evaluation approach. But it should not be overlooked that BPR does not directly change the process characteristics as perceived by the users and hence requires communication effort to change the respective 'resistance' factor. Thus, even with the recommended approach the selection of the 'right' processes for virtualization still requires a profound analysis, since it simply is not an easy task. Nevertheless, consequent adoption of these theoretically founded criteria has the potential to bring prioritization of virtualization efforts to the next level and thus to fruitfully enhance decision outcomes.

Conclusion

This research project is the first to have conducted empirical tests of the PVT in the public sector and has done pioneer work with regard to comparison of multiple processes based on the PVT determinants. In summary, it widely supports the key PVT determinants. Moreover, it further enhances theory by formulation and confirmation of the new EPVT. EPVT meaningfully extends the original PVT by constructs from related, but not yet incorporated literature. It brings together and fruitfully integrates previously fragmented approaches potentially capably for explaining human behavior regarding process virtualization, namely constructs inspired by PVT, perceived risk theory, E-Commerce-related and media richness-related literature. Thereby, EPVT is able to explain 72% of users' resistance toward usage of virtualized processes. Since the significant determinants in the finalized theoretical model all impact users' resistance, the model can certainly be leveraged as an analytical framework for service professionals. By this means, practitioners can predict and compare users' 'resistance toward virtualization' of their services. Such guidance for user-oriented prioritization of e-service efforts is highly appreciated not only in the exemplarily investigated public sector.

Table 5. Appendix: Measurement Items Used, all Employed with Seven-Point Likert Scaling		
ID	Item (translated from German)	Reference
SR1	While I am conducting [the public process], I like to be able to see and touch the rooms and relevant documents. [objects]	Developed based on Overby and Konsynski (2008)
SR2	While I am conducting [the public process], I would like to personally see and hear [the responsible personnel]. [people]	
RR1	The social interaction with the responsible personnel or citizens who are present is important to me during [the public process], because I will thus be kept informed of current events.	
RR2	Personal contact and informal interaction with the responsible personnel or citizens who are present at [the public process] is not important to me. (reverse)	
RR3	It is important to me, to establish a personal relationship of trust with the responsible employees of [the public process].	
RR4	I enjoy talking to the responsible employees or citizens who are present during the different processing steps of [the public process].	
SCR1	It bothers me, if [the administrative office] does not directly start with processing [the public process] when my data is available. [initial delay]	
SCR2	It bothers me, if I do not directly receive [the certificate of the public process] but with delay via mail or e-mail. [additional delay]	
PR1	There is a risk that [the public process] is not conducted satisfactorily on the Internet and that I have to take care of the errors.	Developed based on Featherman and Pavlou (2003)
PR2	It is risky to trust that [the public process] is handled without problems on the Internet.	
PR3	It is risky to rely on the fact that [the public process] is conducted as desired and without any error on the Internet, since I would have to take of errors.	
PR4	I see a risk that [the public process] is not carried out correctly on the Internet and I have to take care of the errors.	
PSR1	It is risky to assume that my data and the documents of [the public process], conducted via Internet, are only used and forwarded in accordance with legal necessities. [data privacy]	
PSR2	I see no risk that criminals have the opportunity to identify themselves with a false identity for [the public process] on the Internet. (reverse) [identity]	
PI1	For [the public process] I like to use a lot of time because it is very important to me.	Developed based on Zaichkowsky (1985) as well as Barki and Hartwick (1994)
PI2	For me, [the public process] is not an event of high personal relevance. (reverse)	
PI3	Personally, [the public process] means very much to me.	
PI4	[The public process] is personally so important to me that I can remember it for a long time.	
NC1	[For the public process], I likely need a consultation.	Developed based on Treviño et al. (2000)
NC2	[For the public process], I presumably do not require consultation.	

	(reverse)	and Järveläinen (2007)
NC3	Certainly, some questions arise before [the public process] can be handled.	
NC4	I presumably do not have any questions with regard to [the public process], thus I can also [conduct the public process] without consultation. (reverse)	
PC1	I assume that many individual formalities are necessary to [conduct the public process].	
PC2	To understand the necessary formalities of [the public process], I probably need little information. (reverse)	
PC3	My information needs to understand the individual processing steps of [the public process] are probably very high.	
PC4	I presume [the public process] to be a complicated incident.	
PA1	During [the public process], I will probably need the confirmation of the employees that I have understood the forms, the necessary procedure or the technical terms correctly.	
PA2	The necessary procedures, forms or technical terms of [the public process], are difficult to understand on my own.	
PA3	The way I see it, the necessary procedures, forms or technical terms of [the public process], are easy to understand on my own. (reverse)	
PA4	I'm assuming that ambiguous forms, technical terms or descriptions are likely to lead to confusion or misunderstandings at [the public process].	
R1	If I had the choice, I would prefer conducting [the public process] on-site (in [the administrative office]).	Self-developed
R2	I prefer to continue the personal handling of [the public process] on-site.	
R3	I would not use the online version of [the public process].	
R4	If possible in the future, I would use the online version of [the public process]. (reverse)	

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