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**Examining the antecedents of the Technology
Acceptance Model within e-procurement**

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Examining the antecedents of the Technology Acceptance Model within e-procurement

Abstract

Purpose: Despite widespread organisational adoption of e-procurement systems, we continue to witness disappointing performance outcomes from their implementation. This can be explained largely by the failure of many organisations to translate the initial adoption decision, made at an organisational level, into individual-level acceptance of e-procurement by an organisation's employees. This study examines the key antecedents of the Technology Acceptance Model for employees expected to use e-procurement systems in their day-to-day activities.

Design/methodology/approach In this study, we apply and extend the Technology Acceptance Model (TAM) to examine factors that influence acceptance of e-procurement by individual employees. Our focus is on the potential role of user-perceived e-procurement quality dimensions as antecedents to the TAM's cognitive mechanisms of perceived usefulness and perceived ease of use. Our structural equation model uses survey data collected from 139 e-procurement users at a university in the Netherlands.

Findings: Our results confirm the core TAM relationships within an e-procurement context. Extending the TAM model to explore antecedents, we find that the e-procurement quality dimensions of *processing*, *usability*, and *professionalism* impact the levels of individual employee e-procurement acceptance. Interestingly, the system level dimensions (*processing* and *usability*) appear to play a greater role than the support dimensions (*professionalism*) in these cognitive mechanisms.

Practical implications: Our findings indicate that the need for e-procurement training and on-going support may be lessened by initial effective design covering system navigation and system usability and by ensuring that an e-procurement system has expedient information and product flows between the buyer and supplier.

Originality/value: To our knowledge, this is the first study to explore the TAM and, more critically, its *antecedents* within an e-procurement context. It is also the first to empirically validate this extended model. Finally, by shifting the focus from the more typical

organisational-level adoption to an individual employee acceptance unit of analysis, we provide a better understanding of how organisations can gain the most from investments in e-procurement and other similar e-Supply Chain Management (eSCM) technologies.

Keywords: E-business technologies, E-procurement, E-procurement quality, Technology Acceptance Model (TAM), Acceptance and Adoption, Survey

1. Introduction

Over the last twenty years, e-procurement has become central to supply chain management (Ba and Johansson, 2008; Brandon-Jones, 2017; Kauppi et al., 2013; Wiengarten et al., 2013). A growing body of literature holds that e-procurement can deliver substantial benefits to organisations, including reduced prices for goods and services, lower transaction costs, reduced supply chain inventories, higher speed, and better levels of customer service (Boone and Ganeshan, 2007; Karjalainen and van Raaij, 2011; Kauppi et al., 2013; Queenan et al., 2011). However, for many organisations implementing e-procurement, we see evidence of the IT paradox, whereby significant gaps exist between investments in and returns on technologies (Autry et al., 2010; Finger et al., 2014). The explanation for the IT paradox lies in the fact that organisational adoption of technology is, in itself, insufficient to generate performance benefits (Jeffers, 2010). To generate performance improvements from a new technology, the organisational-level adoption decision made by senior managers must be followed by individual employee level user acceptance of the adopted technology (Au et al., 2008; Brandon-Jones and Carey, 2011; Chan et al. 2012; Karjalainen and van Raaij, 2011; Rai and Hornyak, 2013). Yet, employee acceptance does not follow organisational adoption axiomatically. Despite the fact that e-procurement technology is now mandated in many organisations, individual acceptance and compliance is often extremely hard to force, with dissatisfied users typically finding ways to circumvent mandated procurement processes (Brandon-Jones, 2017; Karjalainen et al. 2009; Kauppi and van Raaij, 2015; Percy and Giunipero, 2008; Reunis et al. 2006). As such, for organisations seeking to maximise their investments in e-procurement technologies, understanding the antecedents of employee's acceptance is critical (Karjalainen et al., 2009).

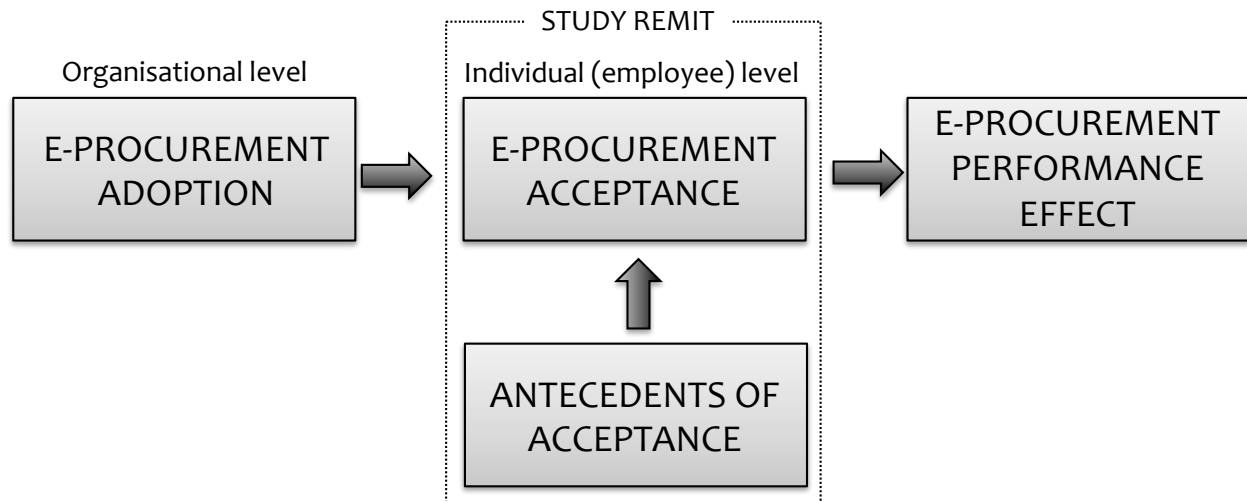
Perhaps unsurprisingly, the majority of Operations Management (OM) scholars examining e-business have used the organisation as their key unit of analysis (Chan et al. 2012; Venkatesh, 2013). For example Au et al. (2014), Davila et al. (2003), Gunasekaran and Ngai (2008), Mishra et al. (2007), Schoenheer (2008), Teo et al. (2009), Toktaş-Palut et al. (2014), and Wu et al. (2007) investigate organisational adoption of e-procurement and other eSCM technologies. Whilst such research is valuable, it underplays the critical role of individual employee-level acceptance that is key in the transition between an organisational-level adoption decision and potential performance effects of e-procurement and other eSCM technologies (Chan et al. 2012; Karjalainen et al., 2009; Miltgen et al. 2013).

There is an increasing recognition that employees' user perceptions play an important role in influencing the success of various e-business projects. In business-to-business (B2B) contexts, user satisfaction is frequently cited as a key driver of technology acceptance and overall e-business success (Au et al., 2008; Autry et al., 2010; Ba and Johansson, 2008). For instance, Cullen and Taylor (2009) illustrate the critical importance of user perceptions on the overall performance of B2B technologies within healthcare pharmaceutical supply networks. Similarly, Queenan et al (2011) demonstrate a clear relationship between perceptions and use of computerised physician order entry systems. Likewise, in the parallel business-to-consumer (B2C) context, a number of studies posit individual customer perceptions of e-service provision as a critical antecedent of behavioural intentions, actual behaviours in the form of loyalty, and performance (Boyer and Hult, 2006; Heim and Field, 2007; Venkatesh et al., 2012).

Within the broader field of information systems research, the Technology Acceptance Model (TAM) is proposed as a cognitive framework that explains how perceived ease of use and perceived usefulness impact on individual usage intentions (Davis et al., 1989). The advantage of an almost law-like model such as the TAM lies in the fact that parts of it can be assumed true, allowing room for deeper study of related constructs (Venkatesh et al., 2007). In this study, we contribute to the discipline by examining the role individual employees' user perceptions of different aspects of e-procurement as antecedents to the TAM's cognitive mechanisms. Focusing on system and support dimensions of e-procurement provision delivered to employees (also termed 'internal customers'), our study examines the extent to which five dimensions of user-perceived e-procurement quality – processing, content, usability, training, and professionalism

(Brandon-Jones, 2017) – act as antecedents to e-procurement acceptance. Figure 1 illustrates the positioning of our research.

Figure 1: Study remit – examining antecedents of e-procurement acceptance



Our study makes a number of key contributions. For academics, we answer calls to explore *antecedents* to the TAM in order to gain a fuller understanding of the factors that influence its cognitive mechanisms (Karahanna et al., 2006; Venkatesh et al. 2007; Venkatesh and Bala, 2008; Autry et al., 2010). We contribute to both information systems and eSCM literature by applying a well-established theory, TAM, in a new context and by extending it with key antecedent constructs related to user-perceived e-procurement quality. In eSCM, we particularly bring the discussion from the previous organisational level adoption to individual employee-level acceptance of the technology. For practitioners, our study contributes to managers who are in the process of implementing e-procurement and similar multiuser technologies. Whilst the TAM alone has predictive ability, it does not provide sufficient managerial guidance on how to enhance individual acceptance of technology (Autry et al., 2010; Venkatesh et al. 2007). Understanding the antecedents of user acceptance is crucial in supporting the roll-out of e-procurement systems once an initial organisational adoption decision has been made.

The rest of the paper is structured as follows. First, we develop our conceptual model of the relationships between e-procurement quality dimensions and the TAM, and present related

hypotheses. We then detail our research methods before presenting our data analysis. The paper concludes with a discussion of our contributions to theory and practice.

2. Conceptual development and hypotheses

In this section, we develop hypotheses that consider e-procurement as a technology acceptance issue. We then examine the potential role of e-procurement quality dimensions as key antecedents to the TAM.

2.1. E-procurement as a technology acceptance issue

The last forty years has seen significant amounts of research examining the adoption (organisational-level) and acceptance (individual-level) of different technologies. Notable work includes the Theory of Reasoned Action (Fishbein and Ajzen, 1975), TAM (Davis, 1989; Davis et al., 1989; Venkatesh and Davis, 2000), Social Cognitive Theory (Bandura, 1986), Theory of Planned Behavior (Ajzen, 1991), Innovation Diffusion Theory (Rogers, 1983), Model of PC Utilization (Thompson et al., 1991), and the Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003). At a broad level, these models illustrate the relationships between attitudes towards technologies and other innovations, behavioural intent, actual organisational adoption and/or individual acceptance, and performance. At the individual level, the dependent variable studied has been constructed as either the behavioural intention or the actual acceptance behaviour (Jeyaraj et al. 2006).

The terms ‘adoption’ and ‘acceptance’ are often used almost synonymously in information systems research, without necessarily distinguishing between the two constructs (Venkatesh et al. 2007). Here specifically, we focus on the intention to use, and we frame our research based on the TAM, which is based on the Theory of Reasoned Action (Venkatesh and Davis, 1996). It is considered to be the most influential of the individual-level acceptance models and its explanation rates are comparably better than its alternatives (Lee et al. 2003; Venkatesh and Davis, 2006). The TAM connects individuals’ cognitive approval (acceptance) of the features of a technology to their behavioral intentions of use and consequently its actual usage (Autry et al. 2010). The core assumptions in the TAM are that an individual’s usage of a technology is mediated by their acceptance of that technology, which in turn is determined by two cognitive

factors, *perceived usefulness* and *perceived ease of use*. Perceived usefulness (PU) is defined as the extent to which an individual believes that using the technology will help improve his/her job performance. Perceived ease of use (PEOU) is defined as the degree to which an individual believes that using a technology is free of effort (Venkatesh and Bala, 2008). If a technology is positively evaluated on these factors its usage will ensue (Autry et al. 2010).

The TAM has been used in a variety of technology contexts and provides accepted and validated explanations to technology usage (Marchand and Raymond, 2008). However, its application within OM remains very limited (van Raaij and Schepers, 2008). Adomavicius et al. (2013) apply the TAM for evaluating decision aids for an economic mechanism in combinatorial auctions, but while their study is at the individual level, the test subjects are students rather than actual e-procurement users. Aboelmaged (2010) has used TAM to examine individual level intention to use e-procurement but surveyed purchasing managers, who can be considered as lead-users or even decision makers of the organisational adoption decision and are thus not typical of the total user population. Finally, Autry et al. (2010) have used TAM in their analysis of supply chain technology but adapted the model from its usual individual level to analyse the firm itself. Thus, we consider it important to extend this theory to e-procurement acceptance at the user/employee level, where previous studies have typically been from a ‘barriers and enablers’ perspective of organisational-level adoption and have not used a clear theoretical framework. Table 1 illustrates key work that has been undertaken at both organisational and individual employee levels of analysis.

Table 1: eSCM research examining organisational-level adoption and individual employee-level acceptance of e-procurement

Step 1: Adoption of an e-procurement technology (managerial decision and investment to purchase technology)	Step 2: Acceptance of an e-procurement technology (individual employee acceptance and usage decision)
<p>Au et al. 2014: technical factors, perceived benefits, conflicts between hotel owners and management, resistance to change, product diversity, and rumours impact e-procurement adoption.</p> <p>Autry et al. 2010: confirm TAM but in firm level technology adoption decisions rather than individual-level as TAM is traditionally used.</p>	<p>Aboelmaged 2010: attitude, usefulness, behavioural control, subjective norm all impact intention to use (Note: managers surveyed to report on all users).</p> <p>Adomavicius et al. 2013: outcome and price feedback impact perceived ease of use and perceived usefulness (Note: lab experiment with students).</p>

<p>Cao et al. 2013: task-technology fit and network externalities impact eSCM technology adoption.</p> <p>Gunasekaran et al. 2009: top management support, streamlined approvals, and workflow and close collaboration with suppliers impact e-procurement adoption in SMEs.</p> <p>Gunasekaran and Ngai 2008: adequate financial support, interoperability and standards with traditional communication systems, top management support impact e-procurement adoption.</p> <p>Pearcy and Giunipero 2008: firm size impacts e-procurement adoption</p> <p>Teo et al. 2009: firm size, top management support, perceived indirect benefits, and business partner influence impact adoption of e-procurement.</p> <p>Wu et al. 2007: organisational learning ability and normative pressures influence company level adoption of e-procurement.</p>	<p>Brandon-Jones, 2017: user perceived e-procurement quality – construct development and replication</p> <p>Cullen and Taylor 2009: information quality, system quality, and trust impact buyers use of B2B e-commerce.</p> <p>Reunis et al. 2004: perceived advantage, communication, demonstration, enforcement, training, involvement, risk reduction, reward, and disposition impact e-procurement acceptance from actor to actor.</p> <p>Reunis et al. 2006: enforcement resulted in an initial system usage by individuals, but persuasive tactics needed to ensure correct e-procurement usage continues.</p>
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In line with extant research, our first five hypotheses are fully consistent with the original TAM and several previous studies (see for example, Moon and Kim, 2001; Robinson et al. 2005; van der Heijden, 2003) and are therefore grouped together. Firstly, we hypothesise that an individual's *intention* to use an e-procurement technology is influenced by their *attitude* towards the technology (H1) (Davis et al. 1989). Furthermore, individuals' intentions to use a technology will be enhanced regardless of their attitude if the technology is expected to increase job performance, and previous research has found that PU directly impacts an individual's behavioural intention to use an online system (Aboelmaged, 2010). Thus, we hypothesise that *PU* positively influences *intention* to use e-procurement (H2).

When a person recognizes the usefulness of a system such as e-procurement in improving their job efficiency, it will positively impact their attitude towards e-procurement (Aboelmaged 2010). Accordingly, we hypothesise that *PU* positively influences an individual's *attitude* toward an e-procurement technology (H3) and *PEOU* will positively influence *attitude* (H4). Finally, and again in line with the original TAM model, we anticipate a direct effect of *perceived ease of use* on *PU* (H5) as improvements in ease of use may also be instrumental in enabling an individual to

accomplish more work with the same effort. A technology that is easier to use will be seen as more useful (Bienstock et al. 2008; Davis et al., 1989).

H1: There is a positive relationship between attitude towards e-procurement and intention to use e-procurement

H2: There is a positive relationship between perceived usefulness (PU) of e-procurement and intention to use e-procurement

H3: There is a positive relationship between perceived usefulness (PU) of e-procurement and attitude towards e-procurement

H4: There is a positive relationship between perceived ease of use (PEOU) of e-procurement and attitude towards e-procurement

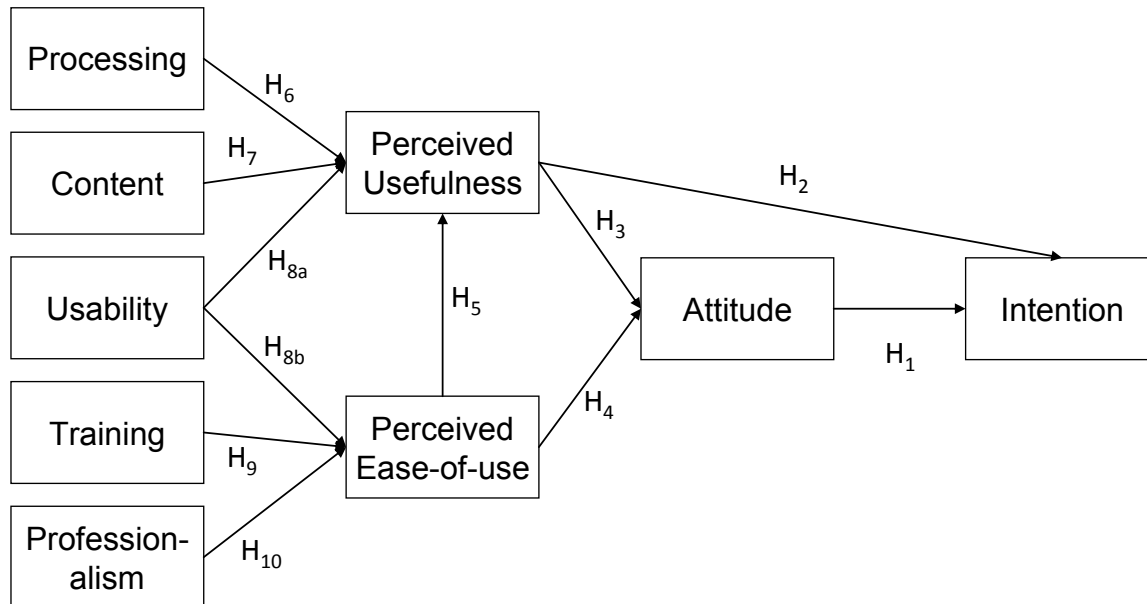
H5: There is a positive relationship between perceived ease of use (PEOU) of e-procurement and perceived usefulness of e-procurement

2.2. E-procurement quality as an antecedent to the TAM

Within the TAM, it is assumed that all effects of external variables are mediated by PU and PEOU (Adomavicius et al. 2013; Karahanna and Straub, 1999; Venkatesh and Bala, 2008;). However, one of the enduring criticisms of the TAM is its failure to explicitly incorporate the various antecedents to the higher order constructs of PU and PEOU (Autry et al., 2010; Venkatesh et al., 2007). Exploring such system and support antecedents provides the opportunity to gain deeper insights to the operational factors at play in acceptance or non-acceptance by individuals when faced with new technologies (Karahanna and Straub, 1999; Karahanna et al., 2006; Robinson et al., 2005; Venkatesh and Bala, 2008). Here, we build on the exploratory empirical investigation of individual user perceptions toward e-procurement system and support provision by Brandon-Jones (2017). In our study, we have examined how five of the six dimensions of user-perceived e-procurement quality – *processing, content, usability, training,* and *professionalism* – act as antecedents to the TAM. A sixth dimension, *specification*, which considers reporting, configurability, and integration with financial management systems, was not included in our model as we expected it to be relevant only to a smaller sub-set of individuals who use e-procurement systems for budgeting, payment and reporting.

Figure 2 shows the model of hypothesised relationships. The right-hand side of this is consistent with the original TAM whilst the left-hand side incorporates the five e-procurement quality dimensions acting as antecedents to the TAM's two cognitive dimensions of PU and PEOU. We now outline each of these hypothesised relationships.

Figure 2: Hypothesised model of e-procurement quality dimensions as antecedents to the TAM



2.2.1 Antecedents to perceived usefulness

As noted earlier, perceived usefulness (PU) is defined as the extent to which an individual believes that their job performance will be improved through the use of a given technology. We hypothesise three antecedents to PU – *processing*, *content*, and *usability*. Firstly, the *processing* dimension of e-procurement quality is concerned with how individuals perceive a new e-procurement technology to impact on order processing speed, ease of authorisation, the time for orders to reach suppliers, overall lead-time, on-time delivery, and order accuracy. As such, it is related to Roger's innovation diffusion model's attribute of relative advantage (Azadegan and Teich, 2010), i.e. the superiority of the technology compared to what it is replacing. Unless individuals can attribute job performance gains to the system they are using, they are unlikely to favour the system, i.e. result demonstrability influences PU (Venkatesh and Davis, 2000). A

similar argument is emphasised in task-technology fit theory, which has been applied to adoption of SCM systems by Cao et al. (2013). They argue that a technology will be used if it supports the needs of the task. In the context of e-procurement, this would relate to the efficiency of processing orders. Such efficiency may emerge from the simplification and streamlining of purchasing processes, reduction in cycle times, and improved accuracy of the information that is transferred between buyers and suppliers (Gunasekaran and Ngai 2008; Kauppi et al. 2013; Tatsis et al. 2006; Toktaş-Palut et al. 2014). Speed is particularly critical to individuals placing orders regularly and empirical evidence indicates that a new system's comparative lead-time plays an important role in user acceptance (Venkatesh and Davis, 2000). As such, we hypothesise that perceptions of *processing* will impact positively on *PU* (H6).

H6: There is a positive relationship between processing of an e-procurement system and perceived usefulness (PU) of e-procurement

Secondly, the *content* dimension considers the adequacy of suppliers and catalogues loaded into an e-procurement system, and how searchable such content is. Information-related characteristics of a system can impact its PU as they can improve productivity and performance (Venkatesh and Bala, 2008). Cao et al. (2013) highlight data quality as an important organisational level antecedent of SCM systems' adoption, and we argue it is also likely to impact *individual level* acceptance of technology. Furthermore, within the field of e-learning, studies (See for example, Cho et al., 2009) emphasize the criticality of good system content in enabling individuals to achieve their learning goals and improve their job performance (i.e. PU). In the context of digital libraries, Thong et al. (2002) argue that matching system content and user's information needs increases PU. Au et al.'s (2014) study of (organisational-level) e-procurement adoption in the hotel industry also highlights the role of rich and accurate information for improving performance. Thus, within the e-procurement context, we hypothesise that *content* will impact positively on *PU* (H7).

H7: There is a positive relationship between content loaded on an e-procurement system and perceived usefulness (PU) of e-procurement

Thirdly, The *usability*² dimension covers system availability, ease of navigation and screen loading speed. Within eSCM, at an individual level, several studies have pointed to system availability, navigation, and speed all playing a central role in the ability of employees to carry out tasks quickly and efficiently (Lai and Tong, 2015; Kull et al., 2007; Wen et al., 2014). A technology that provides information quickly and easily will lead to improvements in job performance, which in turn will encourage greater use of a given technology (Venkatesh and Bala, 2008). User-interface features such as menus and icons are important in the usefulness of a system and allow an individual to perform their tasks more productively (Cho et al., 2009). As such, we hypothesise that *usability* will positively affect *PU* (H8a).

H8a: There is a positive relationship between usability of an e-procurement system and perceived usefulness (PU) of e-procurement

2.2.2 Antecedents to perceived ease of use

As noted earlier, perceived ease of use (PEOU) is defined as the extent to which an individual believes that using a technology is free from effort. We hypothesise three antecedents to PEOU – *usability*, *training*, and *professionalism*. Firstly, considering *usability*, a reliable, flexible and user-friendly system is more likely to create a positive user experience (Venkatesh and Bala 2008). This is in line with Roger’s innovation diffusion work as well as the motivation, opportunity and ability model (MOA), both of which highlight the importance of simplicity in reducing perceived effort associated with the use of new innovations (Azadegan and Teich, 2010). In the context of e-procurement, if a service is slow or down, the system will appear difficult to use for employees and unavailability is likely to limit the proportion of orders placed through the system (Croom and Brandon-Jones, 2007). Thus we hypothesise that this dimension will also have a positive influence on the *PEOU* in the TAM (H8b).

² A key distinction here between concepts is necessary. In the information systems literature, *Usability* is often denoted as ease of use (Venkatesh et al. 2012), defined in the TAM as the extent to which using a technology is free of effort (Venkatesh and Davis, 1996). Our e-procurement construct of *Usability* is different from this concept; more focused on the technical usability of the system (navigation and availability). See items in tables 2 and 3.

H8b: There is a positive relationship between usability of an e-procurement system and perceived ease of use (PEOU) of e-procurement

Secondly, the *training* dimension incorporates the approach to training (e.g. online tutorials, advanced training, refresher courses, group sessions, and one-to-one training), the timing of such training, and the provision of information to support e-procurement system use. Within the e-procurement literature, training is identified as a critical success factor in the initial adoption decision of technology at an organisational level (Au et al., 2014; Gunasekaran and Ngai, 2008; Toktaş-Palut et al., 2014) and subsequently in influencing the perceived effort involved in using such technologies by individuals within the organisation (Reunis et al., 2004). *Training* is especially expected to impact acceptance through PEOU (H9) as it both increases the capability to work with the technology and reduces perceptions of its complexity.

H9: There is a positive relationship between training support and perceived ease of use (PEOU) of e-procurement

Finally, *professionalism* is concerned with the on-going support provided to users who encounter problems, including availability, reliability, responsiveness, knowledge, and attitudes to support personnel. Information systems literature recognizes that people have different abilities to use technologies and that user support is a key predictor of individuals' IT innovation usage (Jeyaraj et al., 2006; Venkatesh et al., 2012). Resources and support are needed to ensure individuals perform a behaviour that is not completely volitional to them (Cheng et al., 2002). Hence support provision contributes to a technology being seen as easy to use and it is seen to facilitate user intentions through its impact on ease of use (Cho et al., 2009; Venkatesh et al., 2012). Au et al. (2014) also note the criticality of reliable and timely support as a key enabler of organisational e-procurement adoption. Hence we expect professionalism to impact positively on PEOU (H10).

H10: There is a positive relationship between professionalism of e-procurement support and perceived ease of use (PEOU) of e-procurement

As shown in figure 2, we do not anticipate that all five dimensions of e-procurement quality will act as antecedents of both PU *and* PEOU. The nature of the *processing* and *content* dimensions, which are strongly focused on the system aspects of e-procurement, are anticipated to align more closely with TAM's cognitive construct of PU – i.e. the way in which an individual expects the technology will affect his or her performance. Conversely, the dimensions of *training* and *professionalism* are more focused on system support rather than perceptions of the system itself and are therefore anticipated to align more closely with the cognitive construct of PEOU – i.e. the degree to which using a given technology is seen as free from effort.

3. Methodology

In this section, we describe the context of our study and present the overall approach to testing our hypotheses, including survey design, data collection, data pre-testing, and data analysis.

3.1. Study context

Our study adopted a deductive survey approach to test hypotheses that emerged from our literature review. The research was undertaken in a business-to-business context examining perspectives of individual employees within buying organisations. These employees are expected to use e-procurement systems to order materials/services from their suppliers. We obtained access to a sample of employees, i.e. individual e-procurement users, at a university in the Netherlands. In line with e-business taxonomies (Boone and Ganeshan, 2007; Karjalainen and van Raaij, 2011; Queenan et al., 2011) e-procurement technologies include online supplier catalogues, electronic purchase order systems, real-time linkages with suppliers, and electronic data interchange (EDI). While the definitions of e-procurement in literature differ slightly, most fundamentally refer to the use of electronic technologies to support the procurement function and the material and services flows into the organisation (Aboelmaged 2010; Chang, et al., 2013; Gunasekaran and Ngai 2008; Tatsis et al., 2006). In our study, the e-procurement system being used by respondents allows individual employees across the organisation to order office supplies, print services, laboratory materials, and computer services online. Seen from an internal service perspective, the purchasing department was the internal service provider and central in driving the initial decision to adopt a new e-procurement system within this organisation. Having done so, the purchasing

department was responsible for implementing the new technology and ensuring its acceptance by employees across all departments and functions.

3.2. Survey design and pilot testing

For the measurement of the latent variables in the model, we used multiple items based on previously published scales. We adapted the wording of existing items to the specific research setting where appropriate. For PU, we adopted four items from Davis et al. (1989). For PEOU, we adopted four items from Thompson et al. (1991) and Moore and Benbasat (1991). For attitude (ATT), we applied the four-item scale used by Venkatesh et al. (2003). Intention to continue system use (INT) was operationalized with three newly developed items. The five dimensions of e-procurement quality were measured using 19 items from Brandon-Jones (2017). All items were measured on a 1-7 Likert scale from 'strongly disagree' to 'strongly agree', with mid points labelled to improve reliability (Zhou and Benton Jr., 2007). Initially, academic colleagues with experience of questionnaire design were asked for feedback on the survey questions, structure and format (Lawson et al., 2008). Subsequently, a pre-test of the questionnaire was carried out with a small group of e-procurement users not involved in the main survey to gauge readability, refine wording, and assess likely completion times (Shah and Ward, 2007). No major changes were required to the survey beyond minor re-phrasing of a number of questions.

3.3. Data collection and pre-testing

The population for our survey was defined as all individual employees using the e-procurement system within the study organisation. Given the population was small (n=311), a census was applied. Initially, we sent out an e-mail via the purchasing department to all employees using the e-procurement system, inviting them to participate in our research project. We followed this up with a direct e-mail to potential respondents (and two further reminders), providing a link to our online survey. We sought to minimise potential method bias by random ordering of questions in our online survey and social desirability bias through assurance of anonymity. Of the 311 potential respondents, 139 completed usable questionnaires, representing a 44.7% response rate. The absolute sample size exceeds most suggestions found in the literature (n>100 Hatcher 1994; Malhotra and Grover, 1998; n=100-200 Velicer and Fava 1998) and is similar to other e-business studies over the last ten years, for example, Autry et al (2010, n=195),

Cullen and Taylor (2009, n=153), Dehning et al (2007, n=123), Devaraj et al (2007, n=120), Menor and Roth (2007, n=168), Rosenzweig (2009, n=50), Vaidyanathan and Devaraj (2008, n=141), Wiengarten et al (2013, n=152) and Zhou and Benton Jr. (2007, n=125). Our respondents are 73% female and 27% male, have a median age of 41-45 years, and are generally in administrative positions.

Prior to data analysis, non-response bias was assessed through wave analysis, comparing the responses of the early respondent wave (first quartile) to those of the late respondent wave (fourth quartile) using two tailed *t*-statistics (Armstrong and Overton, 1977; Rogelberg and Stanton, 2007). No significant differences were found between these two groups in their answers to construct items ($p < .05$). In checking for outliers, Mahalanobis distance testing highlighted just one respondent with a standardised residual +/- three standard deviations from the predicted residual. However, unless one can prove that the outlier is not representative of any observation in the population, it is not advisable to delete it from analysis (Hair et al., 2009), so all data were retained prior to further analysis. Considering missing data, group comparisons of respondents with missing versus valid data showed significant differences between the groups for some items, indicating that simple mean substitution was not the best method for replacing missing data. Therefore, the model-based expectation-maximisation (EM) approach was used to replace all remaining missing data points with the most accurate and reasonable estimate (Hair et al., 2009). EM estimates were constrained to a minimum value of 1 and a maximum value of 7. Finally, Harman's one-factor test was conducted to test for the presence of common method bias (Podsakoff and Organ, 1986). All survey items were entered into an exploratory principal components factor analysis (PCA) with no rotation to identify how many factors are required to account for variable variance (Froehle and Roth, 2004; Shah and Ward, 2007). The presence of substantial common method variance may be shown if a single factor emerges from this analysis or the first factor accounts for the majority of covariance among the variables (Podsakoff et al., 2003). PCA revealed the presence of multiple factors rather than a single general factor suggesting the risk of common method bias is low.

3.4. Data analysis

We used a Structural Equation Modelling (SEM) approach to evaluate our hypothesised model. In this case, we adopted the partial least squares (PLS) approach, which uses a

component-based approach to estimation, instead of a factor-based covariance fitting approach such as LISREAL, EQS, or AMOS. The PLS approach to SEM minimises the demands on measurement scales, sample size and residual distributions (Chin, 1998) and simultaneously models the structural paths (the theoretical relationships among latent variables) and measurement paths (relationships between a latent variable and its indicators) with the main objective of prediction (Chin et al., 2003). Rather than assuming equal weights for all indicators, the PLS algorithm allows each indicator to vary in its weighting towards the latent variable. Firstly, a test of the measurement model is executed to examine item reliabilities, composite reliabilities, convergent validity, and discriminant validity. Secondly, the significance of the structural relationships is assessed using the bootstrap method within PLS.

4. Results

4.1. Testing the measurement model

The first phase of analysis involved testing our measurement model, consisting of all constructs depicted in Figure 2 and their measurement items. The test of the measurement model includes the estimation of internal consistency and the convergent and discriminant validity of the constructs. All constructs are modelled using reflective indicators. All outer loadings of the measurement model are greater than .7, with the exception of one *usability* item (see Table 2) and two items of the *PEOU* construct (see Table 3). Their loadings are considered high enough to remain within the measurement model. All composite reliabilities are at least .838, well above the recommended minimum of .7, indicating adequate internal consistency. For each construct, the average variance extracted (AVE) is at least 0.568, above the recommended minimum of 0.5 to show convergent validity (Fornell and Larcker, 1981).

Table 2: Summary descriptives of the e-procurement quality (EPQ) dimensions

Constructs Items	Mean	St. Dev.	Outer loadings	Composite reliability	Average Variance Extracted
Processing				0.900	0.694
[The system] ensures orders are processed quickly.	5.38	1.491	0.910		
[The system] ensures orders get to suppliers quickly.	5.70	1.322	0.773		

[The system] reduces the lead-time of orders.	5.25	1.686	0.852		
[The system] ensures that orders arrive on time.	5.02	1.653	0.791		
Content				0.870	0.770
[The system] has the right number of suppliers loaded.	4.90	1.446	0.865		
[The system] has the right number of catalogues loaded.	4.70	1.816	0.889		
Usability				0.838	0.639
[The system] is available at all times.	5.49	1.456	0.594		
[The system] moves quickly from one screen to the next.	4.91	1.726	0.877		
[The system] allows easy navigation through the order process.	4.55	1.810	0.891		
Training				0.963	0.928
[Support] provided me with timely training to use the system.	4.22	1.881	0.959		
[Support] provided me with appropriate training to use the system.	4.35	1.765	0.968		
Professionalism				0.953	0.719
[Support] is always available to deal with my queries or problems.	5.47	1.235	0.836		
[Support] always gets back to me when they say they will.	5.56	1.205	0.864		
[Support] responds quickly to my queries or problems.	5.70	1.171	0.802		
[Support] is knowledgeable in dealing with my queries or problems.	5.46	1.241	0.871		
[Support] is flexible when dealing with unusual requests or problems.	5.45	1.303	0.840		
[Support] deals effectively with any mistakes they make.	5.60	1.202	0.882		
[Support] is friendly when dealing with queries or problems.	5.96	1.073	0.799		
[Support] shows concern when dealing with my queries or problems.	5.76	1.122	0.882		

Table 3: Summary descriptives of the TAM dimensions

Constructs Items	Mean	St. Dev.	Outer loadings	Composite reliability	Average Variance Extracted
Perceived ease of use				0.838	0.568
Using the system takes too much time from my normal duties. (r)	5.09	1.855	0.608		
Working with the system is so complicated, it is difficult to understand what is going on. (r)	5.28	1.579	0.696		
Overall, I believe that the system is easy to use.	5.23	1.580	0.877		
Learning to operate the system is easy for me.	5.35	1.459	0.806		

Perceived usefulness					0.949	0.824
I find the system useful in my job.	5.22	1.686	0.908			
Using the system enables me to accomplish my ordering activities more quickly.	4.93	1.836	0.923			
Using the system increases my productivity.	4.31	1.914	0.895			
Using the system makes it easier to do my job.	4.78	1.868	0.904			
Attitude					0.899	0.691
Introducing the system was a good idea.	5.55	1.566	0.778			
The system makes my work more interesting.	3.28	1.769	0.724			
Ordering something through the system is fun.	4.63	1.827	0.904			
I like working with the system.	4.65	1.879	0.904			
Intention to continue use					0.875	0.700
I expect to keep using the system.	5.81	1.564	0.833			
If a product or service can be ordered through the system, I will surely do so.	5.13	1.933	0.863			
If possible, I would rather order a product or service outside of the system. (r)	5.02	2.038	0.813			

The square roots of the AVEs are higher than the correlations across constructs (See table 4), indicating adequate discriminant validity (Fornell and Larcker, 1981). Finally, all blocks with more than one predictor are tested for multicollinearity. For all predictors, the variance inflation factors are 2.6 or lower, well below the suggested level of 10.0 (Hair et al., 2009).

Table 4: Discriminant and convergent validity of the constructs

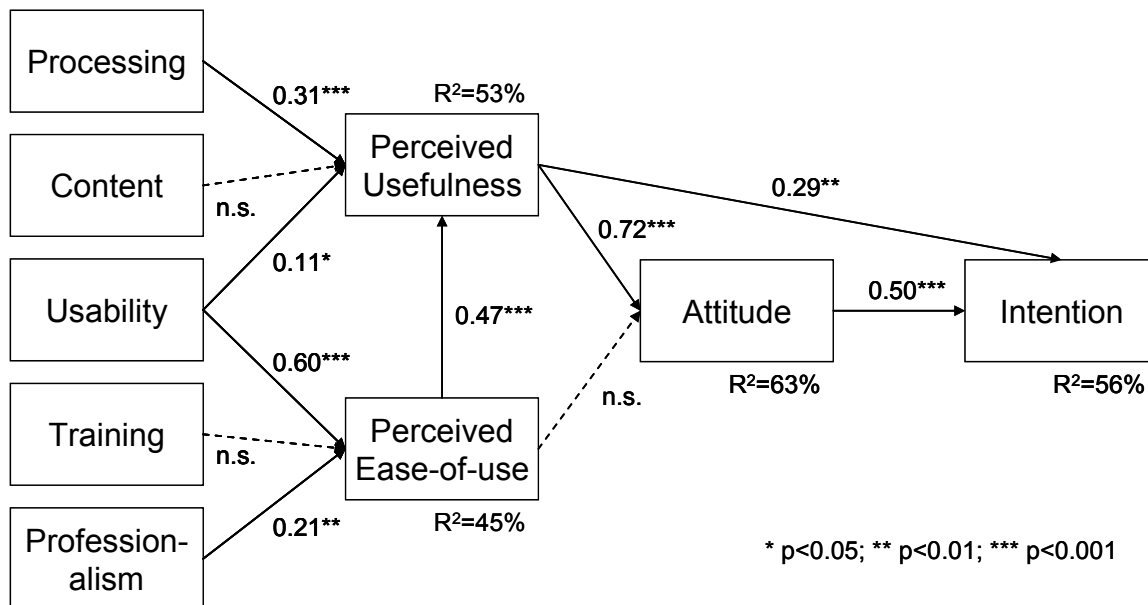
	1	2	3	4	5	6	7	8	9
1 Intent	0.836								
2 Attitude	0.725	0.831							
3 PU	0.680	0.793	0.908						
4 PEOU	0.569	0.571	0.655	0.753					
5 Processing	0.426	0.442	0.510	0.358	0.833				
6 Content	0.267	0.351	0.199	0.139	0.419	0.877			
7 Usability	0.516	0.632	0.539	0.649	0.388	0.381	0.799		
8 Training	0.085	0.087	0.112	0.241	0.173	0.184	0.331	0.963	
9 Professionalism	0.291	0.241	0.350	0.369	0.378	0.173	0.335	0.536	0.848

For adequate convergent validity, the square root of the average variance extracted (AVE) for each construct (on the diagonal) should exceed 0.7. For adequate discriminant validity, the square root of the AVE should exceed all correlations with the other latent variables (reported off-diagonal). These conditions are satisfied for all constructs.

4.2. Testing the structural model

The second phase of analysis involved testing the significance of the paths in our structural model using the bootstrap resampling method within SmartPLS (with 200 resamples). In contrast to covariance structure analysis modelling approaches such as LISREL, PLS has no *single* goodness-of-fit measure, because its primary objective is maximization of variance explained, not minimization of the difference between the observed and the reproduced covariance matrices. The quality of a PLS model can be determined by examining the R^2 values of the endogenous constructs (Hulland, 1999). A graphical summary of all the paths that are significant at a 95% level is presented in Figure 3. Four of the five original TAM hypotheses are supported by the data. Both *attitude* towards the system and *perceived usefulness* of the system are directly related to *intention* to continue using the e-procurement technology (Hypothesis 1 and 2 accepted). *PU* is directly related to *attitude* towards e-procurement (Hypothesis 3 accepted). *Perceived ease-of-use* is directly related to *PU*. (Hypothesis 5 accepted). However, *perceived ease-of-use* is not directly related to *attitude*, and consequently hypothesis 4 is not supported.

Figure 3: Outcomes of the model test



Four of the six hypotheses concerning the antecedents to technology acceptance are also supported by our data. User perceptions of *processing* of an e-procurement system are positively related to the *PU* (Hypothesis 6 accepted). However, the perceived quality of *content* is not significantly related to *PU*, and hypothesis 7 is therefore not supported. Perceived *usability* is positively related to both *PU* (Hypothesis 8a accepted) and *perceived ease-of-use* (Hypothesis 8b accepted). User perceptions of *training* are not related to *perceived ease-of-use*, which means that hypothesis 9 is not supported. Finally, perceived *professionalism* of the support function is positively related to *perceived ease-of-use* (Hypothesis 10 accepted). The model explains 56% of variance in usage intentions, 64% of variance in user attitudes, 53% of variance in *PU*, and 45% of variance in *PEOU*. This explanatory power compares well with other eSCM studies (See for example, Kauppi et al., 2013; Martínez-Caro and Cegarra-Navarro, 2009; Wiengarten et al., 2013).

5. Discussion and conclusion

In this study, we have taken an important step in examining e-procurement quality dimensions as antecedents to the Technology Acceptance Model (TAM) in order to gain a deeper insight into the key factors that influence individual attitudes towards e-procurement and subsequent acceptance (or non-acceptance) behaviours at the employee (user) level, once an organisational investment into the technology has been made. Based on a sample of 139 e-procurement users within an organisation, the core TAM relationships are confirmed in line with previous studies (e.g. Venkatesh and Davis, 1996; Robinson et al., 2005) as well as the hypothesised impacts of *processing*, *usability*, and *professionalism* on higher-order cognitive mechanisms within the TAM. The R^2 of these constructs is substantial, 0.53 for *PU* and 0.45 for *PEOU* respectively, which signifies the importance of e-procurement quality factors in driving individual e-procurement technology acceptance. According to Venkatesh et al. (2007), researching antecedents of the TAM is a key indicator of both scientific progress and practical applicability by creating an in-depth understanding of the phenomenon as well as tools for managerial action. We now examine the theoretical and managerial implications of our study, before concluding with limitations of the research and opportunities for further research.

5.1. Theoretical implications

A significant proportion of extant e-procurement literature focuses on decision-making at an organisational level, investigating the factors that drive organisations towards the adoption of such technologies (Angeles and Nath, 2007; Gunasekaran and Ngai, 2008; Mishra et al. 2007; Wu et al. 2007). What is missing in our field are individual employee level acceptance studies – in other words, examining the way in which organisational adoption can be successfully translated into individual acceptance in order to unlock the performance potential of e-procurement. By examining user-perceived e-procurement quality factors as antecedents to the TAM, our study provides several important theoretical contributions. We respond to the call for more behavioural research in operations management (Bendoly et al., 2006) and to the lack of studies on individual acceptance of e-procurement applications using theories from the broader information systems field by applying the TAM on individual employee usage intentions of e-procurement technology. The empirical analysis provides a number of important implications. At a broad level, the TAM is supported in this application domain, with good support for ‘classic’ TAM hypotheses (H1-H5). Specifically, only the link between perceived ease-of-use and attitude of the TAM model was found to be insignificant in the e-procurement context.

Turning to the antecedents of the TAM, our data indicate that the proposed antecedent e-procurement quality factors explain a substantial proportion of variance in *perceived usefulness* and *perceived ease of use*. This substantiates the original premise of our research that the way various system and support facets of e-procurement provision are perceived by users plays an important role in the formation of the TAM’s higher order cognitive constructs and through them both attitudes towards and intention to use e-procurement technologies. Interestingly, in our study, system issues play a more pronounced role in affecting the TAM constructs than the support issues. *Processing* and *usability* dimensions of user-perceived e-procurement quality appear to be the most important drivers of the TAM constructs, whilst *content* did not show a significant effect. This emphasises previous calls that IT usage research should pay greater attention to the technology itself (Cantamessa et al. 2012). Furthermore, and perhaps more interestingly, it links e-procurement research of employees as users with recent studies on electronic retailing and online ordering, where the quality factors impacting customer decision making have been studied. For example Kull et al. (2007), Olson and Boyer (2005) and Wen et al. (2014) all note that managers need to pay attention to, for example, website complexity,

interface, and availability, so as to ensure competitiveness of their online channels. This is similar to a recent finding of Holma et al. (2015) within the context of corporate travel purchasing, where service quality and well-functioning systems were found to be key to employees' travel purchase compliance, linking corporate travel literature with that of consumer travel.

Our results concerning the way different support facets of e-procurement quality impact the TAM constructs are less conclusive. The *training* factor was not found to be significant whilst *professionalism* had a relatively small effect on *perceived ease of use*. Overall these results are in line with Adomavicius et al. (2013) who find that system characteristics have a significant impact on individual's perceptions of system usefulness and ease of use. Yet our results provide somewhat contradictory evidence when compared to many past studies that bring training and support to the forefront in increasing individual e-procurement acceptance within an organisation (e.g. Kheng and Al-Hawamdeh 2002; Vaidya et al., 2006). Our results would indicate that the need for training may be lessened by the initial design of proper navigation and system usability as well as ensuring the system functionalities in terms of information and ensuing product flow from suppliers are expedient. This fits well with previous organisational-level studies indicating the immaturity of technology as a barrier to e-procurement success (Angeles and Nath, 2007; Gunasekaran et al., 2009).

Naturally, e-procurement technology acceptance may be influenced by a variety of factors. Venkatesh and Bala (2008) present four generic antecedents to the TAM: *individual differences*, *system characteristics*, *social influence*, and *facilitating conditions*. The antecedents explored in this study focus largely on *system characteristics* ("those salient features of a system that can help individuals develop favourable or unfavourable perceptions regarding the usefulness or ease of use of a system", p276) in the form of our *processing*, *content*, and *usability* dimensions, and to a lesser extent the *facilitating conditions* in the form of the *training* and *professionalism* support dimensions. Our results are in line with a review by Jeyaraj et al. (2006) who find that in past studies, facilitating conditions have been among the worst predictors of individual usage behaviour, as training is found insignificant in our study as well. Whilst the system and its support dimensions studied here appear critical in influencing the TAM constructs and ultimately technology usage intentions, other, un-examined issues, such as individual differences, influencing tactics used by managers (social influence), and organisational context are also likely to be germane to behavioural influence and offer opportunities for future research.

Individuals do not come to their assessment of the system in isolation, but rely on others to guide their behaviour. As in other IT usage situations, expert, peer and management interventions are likely to play a role (Jasperson et al., 2005) and, for example, top management support has been found to be critical for successful e-procurement implementation in past research (Gunasekaran and Ngai, 2008). These interventions may act as mediating variables between e-procurement quality factors and the TAM's cognitive mechanisms. The perception of *processing*, for instance, is likely to be partially determined by the way in which the employee has come to know about the system before or even after their own first experience. More research is needed to examine the role of intervention on the formation of employee attitudes towards, and acceptance of, e-procurement.

5.2. Managerial implications

Understanding the antecedents of perceived ease of use and usability is not only important from a theoretical perspective but also from a practical viewpoint as expensive systems can be rejected due to unsuitable user interfaces (Autry et al., 2010). A typical criticism of the TAM is in relation to its lack of practical managerial guidance (Venkatesh and Bala, 2008). The potential business case in favour of organisational adoption of e-procurement can disappear if it is not subsequently followed by individual acceptance within an organisation. As such, our identification of key variables impacting user attitudes towards, and acceptance of, e-procurement appears germane.

Of the five e-procurement quality factors used in the study, *processing* and *usability* have the largest total effect on employee acceptance. As such, managers rolling out an e-procurement system should be particularly aware of the system selection issues that contribute to these scores. *Processing* and *usability* are more important than *content* in this sample. Based on the findings, optimising the order lead-time, performance of the order processes and creating a user interface that is easily understandable, may deserve more attention than the addition of suppliers or catalogues. *Processing* also includes the results of the order fulfilment process. The timely delivery of goods is attributed to system performance and can thereby be seen as the 'the last mile' that deserves attention when seeking to improve user perceptions of e-procurement and through this improve individual acceptance.

5.3. Limitations and future research

Despite making a number of contributions to extant research in the area of eSCM and technology acceptance more broadly, our study has a number of limitations that should be considered when interpreting findings. These limitations also provide directions for future research. The scope of our work is inevitably limited by the variables used in the model. As such, the objective has been to balance comprehensiveness with parsimony. In particular, future work would benefit from exploring potential mediating factors, such as influencing tactics, individual differences, and organisational context discussed earlier.

A second important limitation of our work is the use of *intention* as a proxy for compliance. According to the Theory of Planned Behaviour (see Fishbein and Ajzen, 1975), behavioural intent is the most critical determinant of actual behaviour, and as such the greater the reported intent the greater the actual behaviour (in this case, e-procurement compliance). However, whilst the use of intention as a proxy for behaviour is very common within extant literature, we acknowledge that future studies would benefit from examining actual compliance data and potentially the effect that different levels of usage have on total e-procurement costs.

Thirdly, in common with most other Operations Management (OM) studies, our research is limited by the fact that it has not yet been subject to replication. Whilst still rare in OM, we support the view of Rosenzweig and Roth (2007) that replication is ultimately the best way to progress theory. By applying an established model (i.e. TAM) to a new empirical context (individual employee-level e-procurement acceptance) we have in some ways adopted this replication logic. However, we consider that the next step should be to replicate our *extended* model (i.e. incorporating the antecedents of user-perceived e-procurement quality alongside the TAM) in a related setting. Such studies would allow us to assess the extent to which findings presented here hold true in other sectors, countries, or organisations with different approaches to implementation, for example. Furthermore, Structural Equation Modelling was used to validate our model. We acknowledge that other novel approaches to data analysis may be useful in future work looking to explore the adoption (organisational-level) and acceptance (individual employee level) of e-procurement, as well as other OM phenomena. In a similar vein, a *qualitative* rather than quantitative follow-up study would be valuable in examining the phenomenon of individual-level eSCM acceptance behaviour in more depth.

Finally, whilst we see the individual-level focus of our work as important in developing our understanding of how organisations might overcome the technology paradox, it is clear that our work is limited by not examining antecedents to organisational-level adoption of e-procurement and to other eSCM technologies. Therefore, future research could benefit from a *dual* unit of analysis, which incorporates data on both organisational adoption (non-adoption) *and* subsequent individual acceptance (non-acceptance) behaviours.

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