SMEs’ adoption of enterprise applications
A technology-organisation-environment model

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Abstract

Purpose – This paper aims to empirically explore the TOE (technology-organisation-environment) factors influencing small to medium-sized enterprises’ (SMEs’) adoption of enterprise applications (EA).

Design/methodology/approach – Direct interviews were used to collect data from a random sample of SMEs located in the northwest of England. Using partial least squares (PLS) technique, 102 responses were analysed.

Findings – Results indicate that technology, organisation and environment contexts impact SMEs’ adoption of EA. This suggests that the TOE model is indeed a robust tool to predict the adoption of EA by SMEs.

Research limitations/implications – Although this study focused on examining factors that influence SMEs’ adoption of a set of systems such as CRM and e-procurement, it fails to differentiate between factors influencing each of these applications. The model used in this study can be used by software vendors not only in developing marketing strategies that can target potential SMEs, but also to develop strategies to increase the adoption of EA among SMEs.

Practical implications – This model could be used by software vendors to determine which SMEs they should target with their products. It can also be used by policy makers to develop strategies to increase the rate of EA adoption among SMEs.

Originality/value – This paper provides a model that can predict SMEs’ adoption of EA. SMEs, adoption, enterprise applications, enterprise systems, ICT, PLS, technology-organisation-environment framework, TOE

Keywords Enterprise applications, Enterprise systems, Small to medium-sized enterprises, Technology-organization-environment framework, Communication technologies

Paper type Research paper

Introduction

It is beyond question that a key influence upon the competitiveness of firms of all types is the ability to utilise Information and Communication Technologies (or ICT) (Storey, 1994; Williams, 2007). Most small firms still under-utilise the potential value of ICT by only restricting them to administrative tasks (Brock, 2000). E-commerce adoption by Small and medium-sized enterprises (or SMEs), which is not just about buying and selling goods online, but also about conducting business transactions either within the firm or with external stakeholders, has been thoroughly investigated (e.g. Alonso-Mendo et al., 2009; Stockdale and Standing, 2006; Zappala and Gray, 2006; Daniel and Wilson, 2002). However, SMEs’ adoption of Enterprise Applications (EA), which provide SMEs with opportunities that are largely unexploited, did not
have the same attention. Because SMEs adopting EA may improve their competitive performance, it is important to first understand the factors that influence SMEs’ adoption of EA. This paper aims to achieve this through exploring the TOE (Technology-Organisation-Environment) factors influencing SMEs’ adoption of EA.

Business software packages had their roots in manufacturing resource planning (MRP) systems and started as a support for a variety of transaction-based back office functions at which time they were called enterprise resource planning (ERP) systems (Volkoff et al., 2005). Since then they have evolved to include support for front-office and interorganisational activities including customer relationship management (CRM), and supply chain management (SCM) (Volkoff et al., 2005; Davenport, 2000; Markus and Tanis, 2000). EA are defined as: “commercial software packages that enable the integration of transaction-oriented data and business processes throughout an organization (and perhaps eventually throughout the entire interorganizational supply chain)” (Markus and Tanis, 2000, p. 176). In our definition, EA include ERP, CRM, SCM, and e-procurement systems (Shang and Seddon, 2002).

The attention of software vendors has moved recently to SMEs offering them a vast range of EA, which were formerly only adopted by large firms (Ramdani et al., 2009). SMEs are considered to be a major economic player and a potent source of national, regional and local economic growth (Taylor and Murphy, 2004). SMEs differ from large companies in important ways affecting their information-seeking practices (Buonanno et al., 2005; Lang and Calantone, 1997). Thus, the adoption of ICT in SMEs cannot be seen as a miniaturised version of larger firms.

Without a better understanding of the complex processes and the differentiating factors that affect the level of ICT adoption, the drive to adopt and develop ICT will not successfully contribute to SMEs’ competitiveness (Martin and Matlay, 2001). The question of “why some SME choose to adopt EA, while seemingly similar others facing similar market conditions do not?” is still under-studied. This study intends to fill this gap by exploring technological, organisational and environmental factors influencing EA adoption by SMEs.

Theoretical background
Several theories have been used to examine the adoption/diffusion of ICT in SMEs: technology acceptance model (TAM) (e.g. Grandon and Pearson, 2004); theory of planned behaviour (TPB) (e.g. Harrison et al., 1997); Combined TAM and TPB (e.g. Riemenschneider et al., 2003); TAM2 (e.g. Venkatesh, 2000); diffusion of innovations (DOI) (e.g. Premkumar, 2003); resource-based view (e.g. Mehrtens et al., 2001); stage theory (e.g. Poon and Swatman, 1999); ICT and relationship transformation model (Ritchie and Brindley, 2005); and unified theory of acceptance and use of technology (UTAUT) (e.g. Anderson and Schwager, 2003). While the contributions to this area of research are appreciated, it has been recognised that a large bulk of the literature produced fragmented findings. Researchers seem to investigate the impact of only a limited number of variables, or to pick and choose from a list of factors (Jeyaraj et al., 2006) that have been empirically tested and validated to have influenced the adoption/diffusion of ICT.

The TOE framework developed by Tornatzky and Fleischer (1990) is argued to be an integrative framework that provides a holistic and guiding theoretical basis since research in the adoption/diffusion of ICT typically evaluate various technological,
organisational, and environmental factors that facilitate or inhibit adoption/diffusion. TOE framework has been used to explain the adoption of various innovations (Baker, 2011) including: interorganizational systems (e.g. Mishra et al., 2007), e-business (e.g. Zhu et al., 2006), Electronic Data Interchange (EDI) (e.g. Kuan and Chau, 2001), open systems (e.g. Chau and Tam, 1997), and general applications (e.g. Thong, 1999). This framework has been claimed to be a "generic" theory of technology adoption/diffusion (Zhu et al., 2003) that can be used to study EA adoption by SMEs (Figure 1).

TOE model
This section describes the variables that have emerged from the major constructs in the TOE model.

Technological context
This context can be claimed to have a high impact on SMEs’ adoption of EA. Premkumar (2003) claims that there are very few studies that have examined the impact of technological characteristics on SMEs’ adoption of ICT by SMEs. Relative advantage, compatibility, complexity, trialability and observability are considered to be technological factors that influence EA adoption by SMEs.

Relative Advantage is defined as “the degree to which an innovation is perceived as being better than the idea it supersedes” (Rogers, 2003, p. 229). Previous studies found this variable to be positively related to ICT adoption (e.g. Grandon and Pearson, 2004; Kuan and Chau, 2001). When an ICT is perceived to offer relative advantage over the firm’s current practices, it is more likely to be adopted (Lee et al., 2004). This view has support in the general innovation/diffusion research (e.g. Moore and Benbasat, 1991; Tornatzky and Fleischer, 1990), and more specifically in SMEs’ studies (e.g. Thong, ...

![TOE model of enterprise systems adoption by SMEs](Figure 1)
EA provide many benefits to adopters in terms of accommodating business growth, improving business processes and reducing business operating and administrative costs (Markus and Tanis, 2000). In a highly competitive marketplace, these benefits make significant motivations for adopting these technologies.

Compatibility of an innovation with a business is defined as “the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters” (Rogers, 2003, p. 240). Premkumar (2003) found compatibility to be an important determinant of ICT adoption by SMEs. The adoption of new technologies can bring significant changes to the work practices of businesses and resistance to change is a normal organisational reaction (Premkumar and Roberts, 1999). Therefore, it is important that the changes are compatible with its infrastructure, values and beliefs.

Complexity is defined as “the degree to which an innovation is perceived as relatively difficult to understand and use” (Rogers, 2003, p. 257). The complexity of a technology creates greater uncertainty for successful implementation and therefore increases the risk in the adoption decision (Premkumar and Roberts, 1999). Although this factor has been found to be negatively associated with organisational adoption of ICT (e.g. Grover, 1993; Cooper and Zmud, 1990), it has also been found to be an important determinant of ICT adoption by SMEs (e.g. Thong, 1999).

Trialability is defined as “the degree to which an innovation may be experimented with on limited basis” (Rogers, 2003, p. 258). In the context of small business, Kendall et al. (2001) found trialability to be positively related to e-commerce adoption. The ICT under examination in this study are currently new to the SME market. Hence, trialability is expected to be relevant.

Observability is defined as “the degree to which the results of an innovation are visible to others” (Rogers, 2003, p. 258). In the context of small business, observability is the only attribute out of the five technological characteristics that has not been found to be positively related to organisational adoption of new technologies. ICT that have been seen to make impacts in the industry, in which an SME operates, are more likely to be viewed in a favourable light.

Organisational context
This context can be claimed to have a high impact on SMEs’ adoption of EA. Factors in the organisational context seem to be the primary focus of many studies in SMEs (Premkumar, 2003). Top management support, organisational readiness, ICT experience and size are considered to be organisational factors that influence EA adoption by SMEs.

Top management support has been found to be one of the best predictors of organisational adoption of ICT (Jeyaraj et al., 2006). Top management can stimulate change by communicating and reinforcing values through an articulated vision for the organisation (Thong, 1999). Many studies found top management support to be critical for creating a supportive climate to adopt new technologies (e.g. Premkumar and Roberts, 1999; Grover and Goslar, 1993). In SMEs, the decision maker is very likely to be in the top management team and his/her support is vital for the adoption to take place.

Organisational readiness is defined as “the availability of the needed organisational resources for adoption” (Iacovou et al., 1995, p. 467). Organisational readiness, as used in previous research on EDI adoption, measures whether a firm has sufficient ICT sophistication and financial resources (Iacovou et al., 1995; Swatman and Swatman,
Indeed, economic costs and lack of technical knowledge are identified as two of the most important factors that hinder ICT growth in small firms (Cragg and King, 1993). ICT sophistication assesses whether a firm is technologically ready, while financial resources express an organisation's capital available to invest in ICT (Chwelos et al., 2001).

ICT experience determines whether a firm is deterred from adopting a new technology because of its limited experience with ICT. Previous studies have found that prior ICT experience influences organisational adoption of new technologies (e.g. Kuan and Chau, 2001; Fink, 1998). Dholakia and Kshetri (2002) suggest that technologies already existing in an organisation influence the future adoption of a new technology. They argue that the incremental cost and knowledge required to adopt the Internet, for example, will be much smaller if a firm already owns a computer and a telephone line. This variable has been included in the research model to test whether different categories of firms: SMEs with low-end ICT use, medium-level ICT users, and high-end ICT users (Southern and Tilley, 2000) differ in their adoption of EA.

Size has been identified by Jeyaraj et al. (2006) as one of the best predictors of organisational adoption of ICT. The typical argument is that larger firms have a greater need, resources, skills and experience and the ability to survive failures than smaller firms (Levenburg et al., 2006; Yap, 1990). Thus, it can be argued that larger SMEs are more likely to adopt EA.

Environmental context

This context can be claimed to have a high impact on SMEs’ adoption of EA. Industry, market scope, competitive pressure and external ICT support are considered to be environmental factors that influence EA adoption by SMEs.

Industry in which the firm operates has been argued to influence the adoption of ICT (Levenburg et al., 2006; Raymond, 2001). Service industries, which rely on the processing of information, depend on ICT (Goode and Stevens, 2000). Retail industries, which rely on the transfer of goods, may have a greater dependence on point-of-sale systems (Premkumar and King, 1994). Manufacturing industries rely more on ERP systems. Fallon and Moran (2000) showed that ICT usage varies not only across sectors (i.e. across Standard Industrial Classification) but also within constituent sub-sectors.

Market scope refers to the market area that a firm chooses to operate in from local to international markets. Working on a wider market area introduces a high level of complexity in dealing with legal and cultural issues (Davenport, 1998; Hamel and Prahalad, 1994). As companies become more global and develop international supply chains, the limitation of MRP have become more apparent (Buonanno et al., 2005). Firms tend to expand their ICT infrastructure beyond their organisational boundaries through the development of inter-organisational business systems.

Competitive pressure has been identified by Jeyaraj et al. (2006) as one of the best predictors of organisational adoption of ICT. Competition in the adopter's industry is generally perceived to positively influence the adoption of ICT (Gatignon and Robertson, 1989). This is argued to be even more evident if the innovation directly affects the competition (Kuan and Chau, 2001; Premkumar and Roberts, 1999). Premkumar and Ramamurthy (1995) claim that it can become a strategic necessity to adopt the new technologies to compete in the marketplace.
External ICT support refers to the availability of support for implementing and using ICT (Premkumar and Roberts, 1999). This factor has not only been found to be an important determinant of ICT success (e.g. Delone, 1988; Raymond, 1985), but also to be positively related to organisational adoption of ICT (e.g. Premkumar and Roberts, 1999; Fink, 1998). With the popularity of outsourcing and the growth of third-party’s support, firms are more willing to adopt new ICT if they feel there is adequate third-party’s support (Premkumar and Roberts, 1999).

Research method
FAME (Financial Analysis Made Easy) database was used to retrieve details of SMEs operating in manufacturing, retail and wholesale and service in the northwest of England. It contains information on 3.4 million companies, 2.4 million of which are in a detailed format. A simple random sample of 300 SMEs was chosen and one in four SMEs with complete details were selected.

Firms with fewer than 250 employees were considered to be SMEs (DTI, 2004; EC, 2003). This study used direct interviews to collect information from owner/manager or the ICT manager. Although the interviewer-administered survey technique is expensive and time consuming, it was preferred because it enabled us to gain a fairly good response rate (40 percent). Compared to the response rate standard of 60 percent suggested by Curran and Blackburn (2001), this study’s response rate is not high but falls in line, and even better in some cases, than previous studies (e.g. Grandon and Pearson, 2004, Thong et al., 1996, Premkumar and Potter, 1995).

Because the questions about EA are of contemporary nature, the interviewer-administered survey technique was useful as it enabled the interviewer to correct ambiguities and unfold issues raised by respondents. In conducting the interviews, letters were sent to all firms in our sample frame followed by calls to invite them to participate in the study. Firms with positive responses were asked to provide a date for the researcher to visit the company site and conduct the interview. The respondents were informed that their participation was voluntary and the information they provided was confidential. The characteristics of the sample are shown in Table I. The sample included firms from varying size and from several industry sectors.

Measurement and data analysis
Measures used in the study are presented in Table II. Most of the measures were obtained from previous research whose validity and reliability have been demonstrated. All indicators variables are modelled as reflective because they are

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number of firms</th>
<th>Percent</th>
</tr>
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<tbody>
<tr>
<td><strong>Number of employees</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;10</td>
<td>35</td>
<td>34.3</td>
</tr>
<tr>
<td>10-49</td>
<td>34</td>
<td>33.3</td>
</tr>
<tr>
<td>50-249</td>
<td>33</td>
<td>32.4</td>
</tr>
<tr>
<td><strong>Industry</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>30</td>
<td>29.4</td>
</tr>
<tr>
<td>Retail and wholesale</td>
<td>35</td>
<td>34.3</td>
</tr>
<tr>
<td>Real estate services</td>
<td>37</td>
<td>36.3</td>
</tr>
</tbody>
</table>

Table I. Sample characteristics 
(n = 102)
seen as functions of their associated latent variables. Changes in the latent variable are reflected in changes in the observed indicators (Diamantopoulos and Siguaw, 2006).

Partial least squares (PLS) is a popular Structural Equation Modelling (SEM) technique to conduct data analysis (Goodhue et al., 2006). PLS-Graph was chosen because it is more suitable to handle relatively small sample sizes (Chin, 1998), in comparison to co-variance based SEM techniques like AMOS and LISTREL. Our sample of 102 respondents can be viewed as a small sample size. Also, researchers in this field rely greatly on PLS for testing path models (Marcoulides et al., 2009) and theory confirmation (Chin, 1998).

Validity and reliability

PLS-Graph was used to assess the measurement model in terms of reliability and validity. Validity refers to how accurately the construct reflects what it intends to measure, and reliability refers to the consistency of the results obtained. Several criteria can be used to judge construct validity: face validity, usage principle, convergent and discriminant validity. Face validity was ensured by consulting experts

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Operational measure</th>
<th>Sources</th>
</tr>
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<tbody>
<tr>
<td><strong>Dependent variable</strong></td>
<td></td>
<td></td>
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<tr>
<td>SMEs adoption of EA</td>
<td>Dummy variable</td>
<td>Thong and Yap (1995); Grover (1993)</td>
</tr>
<tr>
<td>1 = Decision to adopt EA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 = Decision to reject EA</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Independent variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relative advantage</td>
<td>Multi-items</td>
<td>Moore and Benbasat (1991)</td>
</tr>
<tr>
<td>Compatibility</td>
<td>Multi-items</td>
<td>Moore and Benbasat (1991)</td>
</tr>
<tr>
<td>Complexity</td>
<td>Multi-items</td>
<td>Moore and Benbasat (1991)</td>
</tr>
<tr>
<td>Trialability</td>
<td>Multi-items</td>
<td>Moore and Benbasat (1991)</td>
</tr>
<tr>
<td>Observability</td>
<td>Multi-items</td>
<td>Moore and Benbasat (1991)</td>
</tr>
<tr>
<td><strong>Technological construct</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Top management support</td>
<td>Multi-items</td>
<td>Yap et al. (1994)</td>
</tr>
<tr>
<td>ICT experience</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 = Low IS users</td>
<td>Multi-items</td>
<td>Southern and Tilley (2000)</td>
</tr>
<tr>
<td>2 = Medium IS users</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 = High IS users</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>Number of employees</td>
<td>DTI (2004)</td>
</tr>
<tr>
<td>1 = 0-9</td>
<td></td>
<td>EC (2003)</td>
</tr>
<tr>
<td>2 = 10-49</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 = 50-249</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Organisational construct</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industry</td>
<td>1 = Manufacturing</td>
<td>Goode and Stevens (2000)</td>
</tr>
<tr>
<td>2 = Retail/Wholesale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 = Services</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Market scope</td>
<td>1 = Local</td>
<td>Buonanno et al. (2005)</td>
</tr>
<tr>
<td>2 = Regional</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 = National</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 = International</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Competitive pressure</td>
<td>Multi-items</td>
<td>Premkumar and Roberts (1999)</td>
</tr>
<tr>
<td>External ICT support</td>
<td>Multi-items</td>
<td>Yap et al. (1994)</td>
</tr>
</tbody>
</table>

Table II. Operationalisation of key variables
in the field and pilot testing of the questionnaires with SMEs’ owners/managers before carrying out the main study. This ensured correcting any ambiguities in measurements as well as capturing correctly the concepts used in this study. Moreover, construct validity is ensured by taking into account the usage principle (Babbie, 2007). The operational measures used in this study were taken from previous work in the field that was published in reputable academic journals. Fornell and Larcker (1981) consider a construct to display convergent validity if the AVE is at least 0.5. This means that the variance explained by the construct is greater than the measurement error. All AVE readings in Table III were above 0.5 with the lowest reading of 0.553. This suggested that there was adequate convergent validity in all measures. Discriminant validity was also established as the indicator variables loaded better on their associated constructs than other constructs as indicated in Table III.

Reliability was also ensured by using face-to-face interviews where the interviewer ensures that each respondent is answering the same questions. Moreover, a quantitative analysis of the measurement model in terms of reliability was performed using PLS-Graph. The acceptable threshold for reliability to exist is loadings at 0.7 and above (Chin, 1998; Gefen et al., 2000). Exceeding this threshold means that there is more shared variance between the construct and its measures than error variance (Barclay et al., 1995). As shown in Table IV, all scales were above 0.7, with complexity being the lowest at 0.829. This indicated that reliability was established in all variables.

Results and discussion
To better predict, explain, and increase the adoption of EA among SMEs, we need to better understand why some SME choose to adopt EA, while seemingly similar others facing similar market conditions do not.

Measures such as path coefficients, which indicated the strengths of the relationships between dependent and independent variables, as well as the \( R^2 \) value, which represented the amount of variance that was explained by the independent variable, were used to assess the proposed relationships. In essence, the \( R^2 \) value was a measure of the predictive power of the dependent variable in the model (Hair et al., 2006; Vogt, 2007). Together the \( R^2 \) and the path coefficients indicated how well the data supported the adopted model.

It was discovered that technological context, organisational context and environmental context had positive impacts on SMEs’ adoption of EA (as shown in Figure 2). Both technological context and organisational context were significant at 1 percent with environmental context being significant at 10 percent. The variance explained by the three independent variables was 0.33.

All three hypotheses were supported at either the 0.01 or 0.10 levels as shown in Table V. Significantly what we need to find out is which specific variables in each of the three constructs have the most important influence on the decision to adopt EA. The results from this analysis are shown in Table VI.

Results from our statistical analysis indicate that technological, organisational and environmental contexts impact the decision to adopt EA by SMEs. Except for ICT experience and external ICT support, all of the other factors were significant at 0.01 apart from size which was significant at 0.05. There are inconclusive results in the literature when it comes to which factors (internal or external) are most influential in SMEs’ adoption of ICT. On the one hand, SMEs take technology adoption decisions
<table>
<thead>
<tr>
<th>Construct</th>
<th>Indicator variable</th>
<th>AVE</th>
<th>Tech. context</th>
<th>Org. context</th>
<th>Env. context</th>
<th>SMEs adoption of EA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technological context</td>
<td>Relative advantage</td>
<td>0.859</td>
<td>0.893</td>
<td>0.317</td>
<td>0.381</td>
<td>0.517</td>
</tr>
<tr>
<td></td>
<td>Compatibility</td>
<td>0.873</td>
<td>0.863</td>
<td>0.244</td>
<td>0.282</td>
<td>0.369</td>
</tr>
<tr>
<td></td>
<td>Complexity</td>
<td>0.553</td>
<td>0.781</td>
<td>0.310</td>
<td>0.156</td>
<td>0.375</td>
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<td>Trialability</td>
<td>0.805</td>
<td>0.834</td>
<td>0.256</td>
<td>0.264</td>
<td>0.233</td>
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<tr>
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<td>Observability</td>
<td>0.841</td>
<td>0.860</td>
<td>0.286</td>
<td>0.243</td>
<td>0.367</td>
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<tr>
<td>Organisational context</td>
<td>Top management support</td>
<td>0.722</td>
<td>0.223</td>
<td>0.731</td>
<td>0.042</td>
<td>0.361</td>
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<td></td>
<td>Organisational readiness</td>
<td>0.862</td>
<td>0.302</td>
<td>0.845</td>
<td>0.040</td>
<td>0.440</td>
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<td>ICT experience</td>
<td>1.000</td>
<td>0.024</td>
<td>0.065</td>
<td>-0.285</td>
<td>-0.011</td>
</tr>
<tr>
<td></td>
<td>Size</td>
<td>1.000</td>
<td>0.391</td>
<td>0.577</td>
<td>0.031</td>
<td>0.167</td>
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<tr>
<td>Environmental context</td>
<td>Industry</td>
<td>1.000</td>
<td>0.382</td>
<td>0.148</td>
<td>0.744</td>
<td>0.258</td>
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<td></td>
<td>Market scope</td>
<td>1.000</td>
<td>0.410</td>
<td>0.236</td>
<td>0.781</td>
<td>0.342</td>
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<td></td>
<td>Competitive pressure</td>
<td>0.787</td>
<td>0.673</td>
<td>0.138</td>
<td>0.613</td>
<td>0.269</td>
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<tr>
<td></td>
<td>External ICT support</td>
<td>0.707</td>
<td>0.236</td>
<td>0.017</td>
<td>0.212</td>
<td>0.086</td>
</tr>
<tr>
<td>SMEs' adoption of EA</td>
<td>Adoption of EA</td>
<td>1.000</td>
<td>0.480</td>
<td>0.464</td>
<td>0.144</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Table III. Convergent/discriminant validities
Composite reliability
Relative advantage 0.968
Compatibility 0.954
Complexity 0.829
Trialability 0.892
Observability 0.913
Top management support 0.912
Organisational readiness 0.926
ICT experience 1.000
Size 1.000
Industry 1.000
Market scope 1.000

Table IV. Reliability analysis
Competitive pressure 0.880
External ICT support 0.921

Figure 2.
Resulting path coefficient with loadings, significance and $R^2$

Notes: Path coefficient with t-value in parentheses; * significant at $p \leq 0.10$; ** significant at $p \leq 0.01$

Table V. Results of hypothesis testing

<table>
<thead>
<tr>
<th>Variable</th>
<th>Hypothesis</th>
<th>Path coefficient</th>
<th>t-stats</th>
<th>Result</th>
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</thead>
<tbody>
<tr>
<td>Technological context</td>
<td>$H1$ Technological context has a high impact on SMEs’ adoption of EA</td>
<td>0.236</td>
<td>2.534**</td>
<td>Supported</td>
</tr>
<tr>
<td>Organisational context</td>
<td>$H2$ Organisational context has a high impact on SMEs’ adoption of EA</td>
<td>0.346</td>
<td>4.339**</td>
<td>Supported</td>
</tr>
<tr>
<td>Environmental context</td>
<td>$H3$ Environmental context has a high impact on SMEs’ adoption of EA</td>
<td>0.139</td>
<td>1.347*</td>
<td>Supported</td>
</tr>
</tbody>
</table>

Notes: *Significant at $p \leq 0.10$; ** significant at $p \leq 0.01$; $R^2$ for adoption of EA = 0.333
based on internal factors (Lee, 2004). On the other hand, Buonanno et al. (2005) argues that the decision regarding the adoption of ERP systems in SMEs is more affected by exogenous reasons than business-related factors.

Technological context has a positive impact on SMEs’ adoption of EA. Relative advantage, compatibility, complexity, trialability and observability have all been found to be significant technological factors in determining EA adoption by SMEs. Consistent with results from previous studies looking at the adoption of other types of ICT (e.g. Kuan and Chau, 2001; Premkumar and Roberts, 1999; Iacovou et al., 1995), relative advantage has been found to be a significant factor in the decision to adopt EA in SMEs. According to Premkumar and Roberts (1999), firms adopt technology only if they perceive a need for the technology to overcome a perceived performance gap or exploit a business opportunity. Some of the benefits of EA mentioned by potential adopters include: accommodating business growth, reducing business operating and administrative costs, and integrating applications cross-functionally. Unlike other types of ICT adoption by SMEs, EA adoption has been found to be influenced by compatibility, complexity, trialability and observability. Compatibility has been significant because incompatibilities in terms of business processes can be a potential deterrent to ICT adoption (Premkumar, 2003). Complexity has also been found to be significant. The lack of in-house ICT expertise may make the adoption of EA seem complex and difficult to implement. Trialability has been found to be another significant technological factor influencing EA adoption by SMEs. Unlike other types of ICT, EA are perceived by SMEs’ managers as a considerable investment and they would like to experiment with these systems before adoption. The availability of EA on

<table>
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<th>Variable</th>
<th>Loadings</th>
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<tbody>
<tr>
<td>Composite reliability = 0.927</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVE = 0.717</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relative advantage</td>
<td>0.893</td>
<td>0.327</td>
<td>7.265**</td>
</tr>
<tr>
<td>Compatibility</td>
<td>0.863</td>
<td>0.233</td>
<td>7.331**</td>
</tr>
<tr>
<td>Complexity</td>
<td>0.781</td>
<td>0.237</td>
<td>5.157**</td>
</tr>
<tr>
<td>Trialability</td>
<td>0.834</td>
<td>0.147</td>
<td>3.116**</td>
</tr>
<tr>
<td>Observability</td>
<td>0.860</td>
<td>0.232</td>
<td>7.505**</td>
</tr>
</tbody>
</table>

Organisational context
Composite reliability = 0.671
AVE = 0.396

| Top management support | 0.730 | 0.494 | 4.778** |
| Organisational readiness | 0.845 | 0.601 | 6.069** |
| ICT experience         | 0.065 | -0.016| 0.116   |
| Size                   | 0.577 | 0.229 | 1.786*  |

Environmental context
Composite reliability = 0.696
AVE = 0.396

| Industry | 0.744 | 0.402 | 3.478** |
| Market scope | 0.781 | 0.532 | 4.347** |
| Competitive pressure | 0.613 | 0.419 | 3.066** |
| External ICT experience | 0.212 | 0.133 | 0.852   |

Notes: *Significant at $p \leq 0.05$, **significant at $p \leq 0.01$
a trial basis can assist SMEs in their decision to adopt these systems. This means that SMEs will be able to assess the performance of EA and would be able to resolve any problems before committing to fully implementing these systems (Ramdani and Kawalek, 2007). Although results of its influence have been inconsistent (Karahanna et al., 1999; Moore and Benbasat, 1991), observability has been found to be significant factor in EA adoption by SMEs.

Organisational context has a positive impact on SMEs’ adoption of EA. Size, top management support and organisational readiness have been found to be significant organisational factors in determining EA adoption by SMEs. Results indicate that size still plays an important role and larger firms in small business category have a greater propensity to adopt EA. This result is consistent with previous studies that have found size to be a critical factor of ICT adoption by SMEs (e.g. Premkumar and Roberts, 1999, Thong, 1999). While larger firms have the resources to invest in new EA, some micro-firms were found to be able to manage their business operations without the need to adopt these technologies. Top management support, which is constantly found to be critical in organisational adoption of ICT, has been found to be a significant factor of EA adoption by SMEs. This is consistent with prior studies in SMEs (e.g. Premkumar, 2003; Premkumar and Roberts, 1999).

The primary decision maker is the owner/manager of an SME, and his or her vision determines the level of support for ICT adoption. SMEs intending to adopt EA have more management commitment that is characterised by inviting software vendors onsite to demonstrate what EA can do for their business (Ramdani and Kawalek, 2007). Top management support becomes more important for EA since it involves interaction with trading partners and establishing business agreements for using these technologies. The use of these technologies could significantly change the way business is done within the organisation as well as externally with its trading partners (Premkumar and Roberts, 1999). Another significant organisational factor is organisational readiness suggesting that without sufficient technological and financial resources, SMEs are unable to adopt EA. This is consistent with the findings from previous studies in SMEs (e.g. Kuan and Chau, 2001; Fink, 1998; Iacovou et al., 1995). The influence of organisational readiness variable may have paled the influence of ICT experience, which has been found to be insignificant. These results are in line with previous findings (e.g. Kuan and Chau, 2001; Fink, 1998; Iacovou et al., 1995).

Environmental context has a positive impact on SMEs’ adoption of EA. Industry, market scope and competitive pressure have been found to be significant organisational factors in determining EA adoption by SMEs. Industry and market scope have rarely been studied in SMEs’ adoption of ICT and rarely included in previous TOE models. Industry has been demonstrated to be a significant factor in EA adoption. Firms with a broader market scope view EA adoption as a way to serve their dispersed markets more efficiently. Serving a broader market area, firms face competitive pressure that characterises international markets (Bartlett and Ghoshal, 1989). Competitive pressure has also been found to be significant. External ICT support has been found to be insignificant. Evidence from prior studies has been inconclusive. On the one hand, Fink (1998) found it to be an important factor, since SMEs appear to value the information provided by software vendors. On the other hand, Premkumar and Roberts (1999) did not find it to be a critical factor in the adoption of
communication technologies. They argued that there could be many reasons for the lack of significance of this variable. One reason could be that SMEs perceive ICT support to be an ongoing expense that they would not like to incur.

This study confirms the findings of previous TOE studies. In the technological context, relative advantage (Lee and Shim, 2007), compatibility, and complexity (Grover, 1993) have been confirmed to be significant. In the organisational context, size (Zhu and Kraemer, 2005), top management support (Grover, 1993), and organisational readiness (Zhu et al., 2004) have also been confirmed to be significant. In the environmental context, competitive pressure (Zhu et al., 2006) has been confirmed to be significant. In addition to these factors, this study found trialability, observability, industry and market scope to be significant factors influencing SMEs’ adoption of ICT.

Conclusion
The major contribution of this study is to empirically explore the TOE factors influencing SMEs’ adoption of EA. The results from the PLS analysis showed that the TOE model is indeed a robust tool for predicting EA adoption in SMEs. This model provides us with the factors that influence the adoption of EA by SMEs. In addition to the factors that were tested in previous TOE studies, this study found trialability, observability, industry and market scope to be significant factors of ICT adoption by SMEs. These factors can be used by EA vendors to determine which SMEs they should target with their products. If these factors exist, then SMEs will be more willing to adopt EA. As there is no “one-size fits all” ICT policy across industries and different sectors use ICT differently (Kotelnikov, 2007; Tan et al., 2010), the findings of this study can be used to develop strategies to increase the rate of EA adoption among SMEs.

The key limitations of this study are as follows. First, although this study focused on the factors that influence the adoption of a set of systems (i.e. ERP, CRM, SCM and e-procurement), it fails to differentiate between factors that influence each of these systems. Second, the study focused on a limited geographical area, which makes it difficult to generalise the results to other UK regions. It would be interesting to look at EA adoption from a cross-country perspective. Third, this study focused on the pre-adoption phase of EA innovation/diffusion process. To gain a more holistic understanding, post-adoption phases should also be examined. Fourth, this study focused on three industries only. It would be interesting to see whether firms in other industry sectors are influenced by the same factors. With the recent popularity of hosted software applications (Lockett et al., 2006), future studies could empirically examine the factors influencing the adoption of these technologies and how they differ from the findings of this study.

References


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