

The Adoption and Impact of ICT in South African SMEs

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Using the Technology-Organisation-Environment model, this study investigates the adoption and impact of information and communications technology by small and medium-sized enterprises in South Africa.

Key Points

1. Governments around the world are increasingly encouraging Small and Medium-sized Enterprises (SMEs) to adopt Information and Communication Technology (ICT), and post-Apartheid South Africa has seen an increasing emphasis on the adoption and use of ICT by SMEs.
2. The study shows that many South African SMEs are confident, mature users of ICT, with owner-managers engaged in ICT decision making alongside other senior managers.
3. There is also evidence of a skills deficit in many SMEs, especially in the black-dominated logistics sector.

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4. The study suggests that government's ICT support and SME policies should better address critical areas such as capacity building, skill upgrading and norm setting at the level of regional economies and industries.

Key words: SMEs, ICT, Johannesburg, TOE, South Africa.

Introduction

Increasing use of information and communications technology (ICT) by businesses make it imperative that we develop a better understanding of the impact of ICT adoption by Small and Medium-sized Enterprises (SMEs). Despite a growing repertoire of SME studies, there is a need for creating a more targeted body of research on ICT adoption by SMEs in the context of developing and emerging economies. This paper extends the work presented at the Institute for Small Business and Entrepreneurship (ISBE) conference by using the Technology-Organisation-Environment (TOE) framework to understand the adoption and impact of ICT by SMEs in the post-Apartheid South Africa (Gono *et al.*, 2013; 2014). Specifically, the paper answers the following research question: What are the factors and processes that affect the adoption and impact of ICT by SMEs in the South African manufacturing and logistics sectors? To achieve this objective, the paper examines the perceptions of owner managers in relation to technological, organisational and environmental factors that affect the adoption and impact of ICT in their firms.

During the Apartheid era government policies caused South African industry to be dominated by large firms that relied on subsidies and suppressed SMEs and this, along with high import tariffs and economic sanctions, created a challenging environment for firms to improve productivity (Joffe *et al.*, 2005). A key issue facing the South African government in the transition from a centrally planned Apartheid regime into an open

market economy is the urgency to develop the SME sector as part of a wider social and economic restructuring. SMEs are estimated to account for 90 percent of South Africa's business establishments (Smit and Watkins, 2012), contributing between 52 – 57 percent towards the country's GDP and 61 percent towards employment (see also Goldstuck, 2012). Similar to the size dimensions used in the UK (Clear *et al.*, 2013), the Department of Trade and Industry of South Africa (DTI, 2008) indicates that micro-enterprises (≤ 5 employees) provide employment for 17 percent of the workforce, small enterprises (≤ 50 employees) for 21 percent, and medium-sized enterprises (≤ 200 employees) for 18 percent of employment. Large enterprises make up the balance (44 percent).

SMEs are a source of employment, new business ideas and poverty alleviation (Wolf, 2001; UNDP, 2011). These firms arguably carry more importance in today's global economy earmarked by relationships, networks and information intensity (Tse and Soufani, 2003). Research on SMEs has examined a variety of outcomes as a result of ICT adoption and use in both developing and developed economies. Studies show that resource constraints often hamper investments in information technology (Beck and Demircuc-Kunt, 2006). The literature also suggests that ICT adoption decisions in SMEs are the sole provenance of owner-managers (Caldeira and Ward, 2002; Beckinsale *et al.*, 2006), however, there exists evidence showing that external factors such as suppliers (Beckinsale *et al.*, 2006) and ICT consultants (Bathgate, 2013) also strongly influence ICT adoption and mediate their impact.

The paper will proceed with a brief discussion on approaches used in the SMEs/ICT literature and the theoretical foundations of the TOE framework used in this study. The methodology section will provide information on the methods used, including the data set and statistical analyses as well as interviews conducted. This is followed by a discussion

of the three themes that form the framework: technological, organisational, and environmental constructs. In the final section the results and discussions are presented.

Theoretical Background

The range of approaches and theoretical foci used in SMEs/ICT literature is diverse: the Diffusion of Innovations approach (DOI) (Rogers, 1995; Parker and Castleman, 2009), Technology Acceptance Model (TAM) (Davis *et al.*, 1989; Venkatesh, 2000; Devos *et al.*, 2012), Resource-based Theory (RBT) (Caldeira and Ward, 2002; Barney, 2012) and the Technology-Organisation-Environment framework (Tornatzky and Fleischer, 1990; Baker, 2012) are among some of the most widely used theories in Information Systems research on SMEs. Although these theoretical approaches provide a lens for examining the use of ICT by SMEs and their contributions, most of this research is set in the context of developed economies. In addition, the literature also shows a tendency to selectively test factors affecting ICT adoption and use (Ramdani *et al.*, 2013). We employ the TOE framework to investigate the adoption and impact of ICT by South African SMEs since it provides a stronger contextual model to analyse the firm level aspects along with environmental considerations of ICT deployment.

The technology - organisation - environment (TOE) framework

Tornatzky and Fleischer's (1990) TOE is an integrative framework providing a holistic theoretical basis for research on ICT issues in SMEs by exploring technological, organisational, and environmental factors that affect the use of ICT (Ramdani *et al.*, 2013). Due to its wide applicability (Zhu *et al.*, 2003) and broad coverage of themes, it is a suitable framework for exploring ICT issues at the firm level. Literature suggests that SMEs are poor at exploiting ICT (Levy *et al.*, 2003). In the developing country context,

especially in the unique post-Apartheid setting, it is important to understand the factors that influence the adoption and impact of ICT in SMEs.

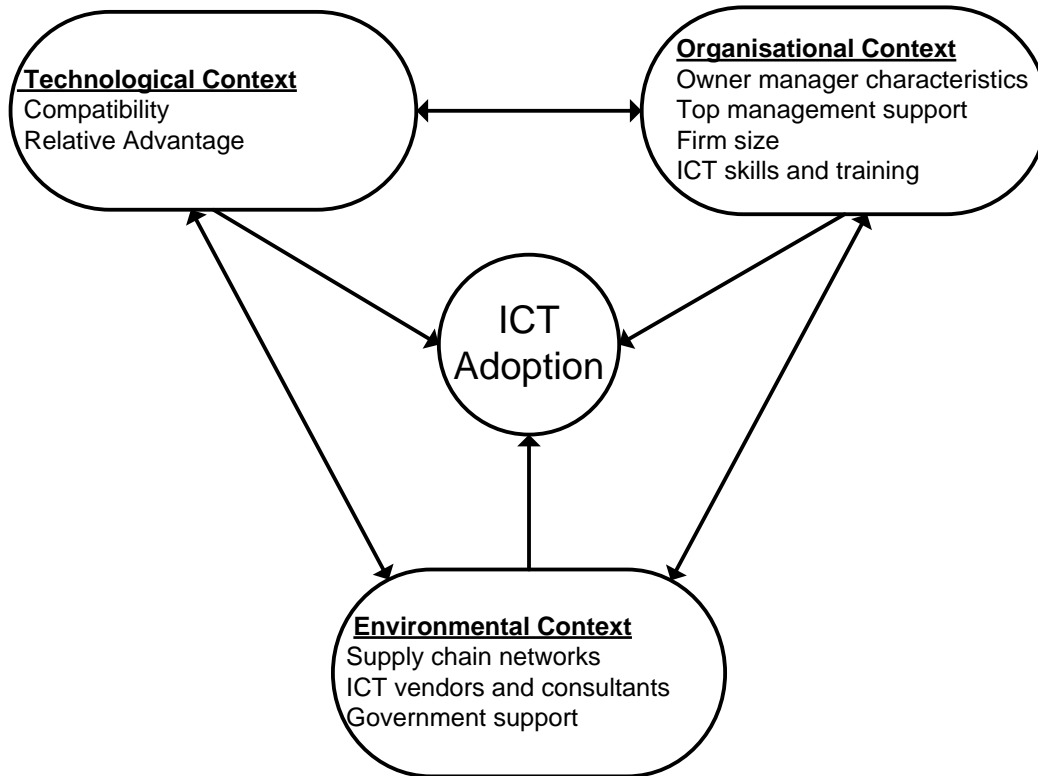


Figure 1 A Model of ICT Adoption by South African SMEs

Source: Adapted from Tornatzky and Fleischer (1990)

Figure 1 presents an adapted model based on the TOE framework that brings together a range of technological, organisational and environmental factors, identified in the literature, that are deemed to impact the attitude of owner-managers towards ICT in SMEs, and hence its adoption and impact within the firm. The applicability of the TOE framework for investigating ICT issues in SMEs is exemplified in existing Information Systems (IS) literature. In their investigation of SMEs' adoption of enterprise systems using the TOE framework, Ramdani *et al* (2009) found that SMEs were more influenced by technological and organisational factors than environmental factors. Ifinedo's (2009)

study using the TOE framework to examine the determinants of e-business adoption by Canadian SMEs found top management support as the most significant factor. In their TOE-based study of e-commerce in Malaysian SMEs, Ahmad *et al* (2014) found perceived relative advantage, perceived compatibility, managers/owner's knowledge and expertise as having the most impact on adoption. Importantly, they also found organisational context related factors significant in contributing towards e-commerce adoption. Alshamaila *et al.*'s (2013) TOE study of cloud computing adoption by SMEs in the North East of England found factors such as relative advantage, compatibility, size, top management support, prior experience, and supplier efforts as playing a key role. Several other studies have also used TOE to examine the adoption and use of ICT, including Kuan and Chau's (2001) study of EDI adoption, Zhu *et al.*'s study on e-business adoption (2006) and Low *et al.*'s study on the use of cloud computing (2011).

The use of the TOE framework as the guiding theoretical lens in this study is critical in unveiling a context-based understanding of factors affecting adoption and impact of ICT. It helps us understand the strategies and capabilities that enable firms to derive superior value from ICT in different TOE contexts. Theories such as the Resource-Based Theory of the firm (RBT) (Barney, 1991) argue that the internal capabilities of the firm play a key role in the competitiveness. However, in a transitional economy like South Africa that is heavily dependent on the enactment of legislation, and facing the challenges of a recently introduced market economy, the TOE framework provides a holistic theoretical basis. This includes both RBT-influenced capabilities of the firm as well as other critical and contextual factors. Based on the framework, the technological (compatibility and relative advantage), organisational (owner-manager, top management support, firm size

and age, and ICT skills and training), and environmental (supply chain, ICT consultants and vendors, government support) factors are examined further in the section below.

The Technology context

The TOE's technology context represents a pool of technologies available to a firm for adoption and use as well as their compatibility with technologies already in use in the firm and relative advantage arising from their use. The existing technologies used in a firm influence further adoption and use of new technologies because they set a broad limit on the scope and pace of technological change that a firm can undertake based on familiarity and awareness (Collins *et al.*, 1988). The complexity of a technology creates uncertainty for successful implementation and therefore increases the risk in using that technology (Premkumar and Roberts, 1999). It is important to investigate the extent to which changes and innovations brought about by technology affect the ability of a firm to derive value from its configuration of strategies (Rashidirad *et al.*, 2014).

The Organisation

The organisational context refers to the characteristics and resources of the firm. In this context they include factors internal to the organisation that constrain or facilitate adoption such as top management support, resources or constraints and firm size and age. While these represent internal factors, informal external links are also associated with ICT adoption, such as linkages with ICT consultants/vendors (see discussion on environment section). Top management can foster innovation by creating a platform that welcomes change and is supportive of innovations that further the firm's core mission and vision (Tushman and Nadler, 1986). Research suggests that ICT experience and firm size also influence SMEs' use of technology (Jeyaraj *et al.*, 2006; and Ramdani *et al.*, 2009). Larger organisations are generally more likely to undertake innovations, but much

of this research has been criticised on the grounds that size is often a crude proxy for more specific and more meaningful underlying organisational factors such as the availability of specific resources (Kimberly, 1976). As a result, a link between size and innovation cannot be conclusively established, and researchers argue for the use of more specific measures of organisational variables that represent firm resources as opposed to the generic measure of size.

The Environment

The environmental context includes the structure of the industry, the presence or absence of technology service providers, and the regulatory setting (Baker, 2012). Also, dominant firms within the supply chain are perceived to influence other supply chain partners to innovate (Kamath and Liker 1994). These external factors affect a firm's decision to use a technology, either directly or indirectly and thereby shape their impact. Awa *et al.* (2012) noted competitive pressure, trading partners' readiness, socio-cultural issues, government support and technology support infrastructures such as quality ICT consulting services as relevant factors for ICT use and impact in SMEs (see also Jeyaraj *et al.*, 2006; Scupola, 2009). Duan *et al.* (2012) describe the firm's environment as the macro area in which an organisation conducts the business, consisting of competitors and the government. Premkumar and Roberts (1999) identified relative competitive advantage, top management support, organisational size, external pressure and competitive pressure attributes as critical determinants for ICT adoption and impact in SMEs. Mehrtens *et al.*'s (2001) study of the use of the Internet in SMEs showed the key role played by organisational readiness, external pressure and perceived benefits.

In view of the discussion above, the attributes highlighted in the TOE framework can be extended for studying the adoption and use of ICT in the manufacturing and logistics

sectors of South Africa. Though the TOE framework discusses external environment, it does not make a distinction between the impact of the market and regulatory contexts on SMEs. This is an important shortcoming of the model as the effects and origins of the two contexts are different. One is influenced by the structure of the industry while the latter is shaped by the work of the government. In a transitional economy like that of South Africa, government regulations play a critical role for change and this should therefore be seen as a distinct context from the market environment.

Methodology

To explain the adoption and impact of ICT in SMEs, it is necessary that we understand the perspectives of owner-managers and other actors involved in these processes. We combine qualitative and quantitative methods as both approaches help develop rich insights into various phenomena of interest that cannot be fully understood using a single method (Venkatesh *et al.*, 2013). A questionnaire survey was undertaken in 130 SMEs operating in the Johannesburg manufacturing and logistics industries. It consisted of eighteen mostly Likert scale type or multiple options questions and three open ended questions. The sample data was gathered using a contact list compiled from the Brabys Business Directory and the database of the Chartered Institute of Transport and Logistics of South Africa (CILTSA) for logistics firms, and from SIC codes between 2320 and 3130 for manufacturing firms and 6023 – 6302 for logistics firms (UNSTATS, 2013). In total, out of 500 emails sent to the firms, we received 134 replies of which 130 were valid. This represents a 26 percent response rate which is comparable to those recorded by other studies in SME/ICT research (for example, Karami *et al.* (2006) recorded 27 percent and Ghobhakloo *et al.* (2011) 18.4 percent). Of those 130 firms, 64 firms were from manufacturing and 66 from logistics sectors. Firms are hitherto referred to as Log 01, 02,

etc. for logistics or Man 01, 02 etc., for manufacturing. Table 1 shows the demographics of our sample below:

No. of employees	≤ 10 (micro)	11-49 (small)	50-99 (medium)	100-200 (medium)	Unknown ²
No. of firms in sample	16	45	25	27	17
Annual Revenue	≤ R5 million	R5 – 10 million	R10 – 20 million	R20 – 40 million	Unknown
No. of firms in sample	32	26	39	16	17
Age	≤ 5 years	5 – 10 years	10 years and above	Unknown	
No. of firms in sample	10	22	97	1	

Source: Author
 NB: 1Rand= £17.96 (August 2014)

Table 1 SME Sample Demographics

Most of the measures were obtained from previous research whose validity and reliability have been demonstrated for measuring ICT adoption and use. Similar approaches were used by Thong (1999) and also by Ramdani *et al.* (2013). For example, competition was measured based on Porter and Millar's (1985) concept of competitive forces that included level of rivalry among firms in the same industry.

The survey data was analysed using SPSS, and the Kruskal-Wallis measure was employed to indicate the strength of the relationship between dependent and independent variables. These were used to assess the proposed relationships with the coefficients

² These firms did not indicate their age, revenues or number of employees.

generated indicating how well the data supported (or not) factors constituting the framework.

In addition, semi-structured interviews were conducted with 52 interviewees comprising 19 owner-managers, 26 senior managers (e.g. head of department, financial managers etc.), 4 sector representatives, 2 ICT consultants/vendors and a leading expert in academia. Each interview was around one hour in length. The interview data was analysed using Atlas ti qualitative data analysis software. In line with Dyerson *et al.* (2009), the typical respondent was either the owner-manager or the designated person responsible for ICT adoption initiatives.

Each source of data generated by both methods represents an important piece in a jigsaw. The goal of the quantitative data is to provide a sense of the degree to which particular views regarding ICT adoption and impact are held by owner-managers in the chosen sectors. The responses to the semi-structured questions gave the interviewees the opportunity to express their views in areas that did not lend themselves to survey questions or to amplify their comments. Together, the results of the survey and interviews offer opportunities for data triangulation.

Results and Discussion

We now present the results from the survey and interviews to illustrate technological, organisational and environmental contexts of the adoption and impact of ICT by SMEs in the South African context.

The Technology context

The technological context has a high impact on SMEs' adoption of ICT. Compatibility, and relative advantage are found to be significant in determining ICT adoption and impact.

Compatibility

Unless the firm benefits from technology adoption and owner-managers are able to assess the opportunities that can be derived from ICT use, they may find it difficult to justify investment in ICT. Surprisingly, more than half of the survey respondents indicated that the acquired ICT was 'compatible' and 'highly compatible' with existing organisational systems highlighting a recognition of the need to integrate ICT with business objectives and processes. As shown by the interview quotes below, this was mainly as a result of system upgrades (see Man 01 below), internal expertise (see Log 01 below), and minor adjustments made to the acquired ICT so as to fit the organisational structure.

'We upgrade our systems to match production process systems. This leads to improved production, efficient operations and less maintenance than before as problems are highlighted in advance' (Man 01, Director).

'Integrating all systems is a challenge but this is managed internally. We develop our own systems so we adjust to facilitate compatibility. As well, from time to time we re-configure our systems just as a preventative maintenance procedure; hence we have seen fewer problems as a result of this pro-active strategy' (Log 01, IT Manager).

We also noted a relationship between ICT compatibility and age of the firm, shown by a Kruskal-Wallis coefficient of $p \leq 0.02$ (see Appendix 1 and 2). Consistent with these results, Steyn and Leonard (2012) also found ICT compatibility with a user's job functions as an important factor in the adoption and use of ICT. Looking at the

relationship between the educational levels of the owner-managers and ICT compatibility in the firms, 22 of the owner-managers with a tertiary qualification (17 percent of respondents) and 21 having a degree or above (16 percent of respondents) reported that adopted ICT were compatible with existing organisational systems. These findings are validated by a Kruskal-Wallis test analysis which showed a significant relationship between level of education and ICT compatibility of $p \leq 0.02$ (see Appendix 1 and 2). Around 8 percent of the firms reported incompatibility with acquired ICT. Technological incompatibilities constrain the effective use of ICT and makes it harder for firms to benefit from the ICT adopted. This suggests that firms acquiring ICT that are incompatible with business practices may lack adequate technical skills and capability, and may therefore benefit from the support of government, sector institutions or consultants in this regard. Indeed as shown later in the paper, sourcing the right advice, external expertise and the software emerge to be a significant challenge for SMEs.

Relative Advantage

Consistent with results from previous studies (e.g. Iacovou *et al.*, 1995; Premkumar and Roberts, 1999) relative advantage was found to be a significant factor in the decision to use ICT (see also Ramdani *et al.*, 2013). According to Premkumar and Roberts (1999), firms use technology only if they perceive a need for the technology to overcome a perceived performance gap or exploit a business opportunity. In most of the SMEs we studied some of the notable impacts of ICT span a wide spectrum: integrating ICT to allow inter-firm exchange, enhanced participation in the supply chain, and also to obtain efficiency advantages in a variety of processes. For example:

‘Clear communication links with SARS (South African Revenue Services) has enhanced efficiency and effectiveness, reduced time wastage’ (Log 08, Financial Manager).

ICT was also seen to be assisting firms in gaining market share by expanding into previously inaccessible markets through partnering with large firms like TNT, DHL etc. This allowed SMEs to enter into collaborative relationships by overcoming infrastructural constraints as noted below:

'...technology has allowed us to work with DHL and TNT Express. We deliver or collect parcels on behalf of these organisations in addition to serving our own smaller customers' (Log 04, Owner-Manager).

Most of the SMEs were clearly aware of the need to invest in ICT where there were clear business benefits and impacts. This implies a certain confidence in the SMEs studied. An exemplary point was made by the IT manager of Log 01:

'If there is a need that has been identified, we look at the cost, compatibility and organisational need. If the ICT is worth our attention and investment, we will consider it' (Log 01, IT Manager).

Organisational context

In relation to the organisational context, we discuss the owner-manager characteristics and top management support, ICT skills and expertise, firm age and size as important factors influencing ICT adoption and impacts.

Owner-manager knowledge and level of education

Results show that 45 percent of the respondents had a tertiary qualification (certificate or diploma) with 39 percent having a degree or above. The level of the owner-manager's education had a positive relationship with ICT satisfaction ($p \leq 0.00$) as most educated owner-managers reported being satisfied with their ICT. Of the owner-managers with a

tertiary qualification or above, 63 percent viewed government guidance as least important as they used their own experience and skills to implement ICT in their firms. This supports conclusions of a study by Finmark Trust (2010) who found most of the Johannesburg owner-managers to have had progressed beyond the standard 10 (post-matric) qualification. This status entails that Johannesburg owner-managers have better access to resources, business networks and education, with many of the owner-managers being of white ethnicity.

These observations support findings by other studies that revealed individual characteristics of the owner-manager such as age and experience, knowledge of ICT, gender, and ethnicity as widely believed to influence ICT use in SMEs (Beckinsale and Ram, 2006; Manuelli *et al.*, 2007). Because of their size and lack of resources, most SMEs do not have specialised ICT knowledge and technical skills (Harindranath *et al.*, 2008). This according to Elbeltagi *et al* (2013) leads to the assumption that if an SME is led by an owner-manager who lacks basic ICT knowledge, then the firm will miss out on the potential impacts of ICT on their business.

Top management support

Top management support entails providing essential involvement and motivational aspects for the successful introduction and use of new ICT (Al-qirim, 2007; Spinelli *et al.*, 2013). Findings showed some sectoral differences in the use of ICT with owner-managers in the logistics sector making the majority of primary decisions as a result of using less complex ICT. This is in contrast to manufacturing sector owner-managers who delegated some aspects of the decision making process to experts (with 86 percent of manufacturing sector owner-managers making use of ICT vendors/consultants as sources of advice). Across both sectors, this may be a result of SMEs adopting a more formal

consultative process involving senior managers and other professionals within and external to the firm seeking a more informed input as shown by the interview comment below:

'...decisions are mainly made by the IT manager/Finance Director, but will meet together with other senior personnel and will hold a meeting to discuss new ICT and the potential benefits to be attained' (Log 02, IT Manager).

'...mainly the head of that department makes the decision regarding the technologies to be used but this will be discussed with other senior managers' (Man 02, Owner-Manager).

These and other similar comments from interviews point out that senior managers are increasingly becoming influential in the ICT adoption process. Indeed, results show that 14 percent of owner-managers are delegating secondary decision-making to senior managers. Hence, senior managers have an impact on ICT adoption as they stimulated change by communicating key ICT adoption options to owner-managers.

While top management perspectives and attitudes towards ICT adoption remain significant, we note a shift from sole decision making attributes of owner-managers to more acceptance of senior managers taking some responsibility for ICT decisions; this is contrary to some of the literature that identifies owner-managers as having the sole authority and responsibility for IT decisions in SMEs (Antlova, 2009).

The findings illustrated that where owner-managers and senior managers are more involved, firms seem to be benefitting more from ICT use as their involvement often translates to better understanding of the need for continued support, training and skills development, ensuring that all ICT purchased are linked to business objectives or needs.

For instance, an owner-manager argues his point as below:

‘...no IT problems at the moment, we do our own training internally and we are very experienced to handle any operational issues presently. We have the skills in-house for our current requirements..... Since we are a fairly small organisation, two senior managers are fully involved with ICT decision-making, then we will cascade the skills or information to the rest of the staff when a decision is made the ICTs’ benefits. As the owner-manager, I fully support the process of adoption and currently we are satisfied’ (Log 07, Owner-Manager).

This is similar to observations by Caldeira and Ward (2003) who found that top management involvement led to superior levels of satisfaction with ICT in Portuguese manufacturing SMEs.

Firm Size and ICT adoption

Findings point out that the majority of firms (55) making up 42 percent of the respondents were of medium-sized SMEs and can therefore be seen as mature firms³ (see Table 1 above). A chi-square test analysis shows a significant relationship between firm revenues and firm age ($p \leq 0.00$) (See Appendix 1 and 2), with values of less than 0.05 ($p \leq 0.05$) assumed to signify a significant relationship. Most owner managers of such medium sized firms indicated no concern with regards to financing of ICT initiatives:

‘We are well resourced, skilled, develop our own IT systems and have the ability to implement a lot of IT with no need for external assistance’ (Log 02, IT Manager).

These observations support conclusions drawn by Ghobakhloo *et al.* (2012) who suggested that the size of the firm had a positive impact on ICT adoption. While age of

³ Firms which are 10 years and older are considered mature, firms between 5-10 years old are considered to be in transition, and those 5 years and younger are considered growing firms (Özcan, 1995a).

the firm signifies stability resulting from market knowledge and resource advantages, size allowed for resources to finance ICT and to develop and/or acquire necessary skills.

ICT Skills and Training in SMEs

The lack of ICT skills has been cited as an area of concern and remains a key challenge for many SMEs in South Africa; it has become the ‘new currency’ for SMEs. Having internal expertise is critical for ensuring business impact of ICT. Across both sectors 75 percent of the respondents indicated that lack of training among employees was a major concern. From the interviews conducted, it was apparent that most SMEs did not employ qualified technical people. This led to the reliance on external ICT providers who acted invariably as ICT consultants, implementers and trainers for SME owner-managers and their staff. Where there was clear evidence of in-house ICT skills (see Log 05 excerpt below), ICT satisfaction was high, as often highlighted in the literature (Ghobakhloo *et al.*, 2012):

‘...we are very satisfied....yes we have also developed our own systems in-house. We have very capable staff capable of implementation of both in-house ICT and those acquired off the shelf’ (Log 05, IT Operations Manager).

While most of the owner-managers interviewed value ICT training as ‘very important’, the cost of such training and time spent necessitates that they try and recruit qualified personnel so as to minimise training costs:

‘Training is key to our operations; however we are lucky in that the suppliers of machinery and manufacturing software are responsible for training our staff. If we think our employees need more training they are willing to train our staff. The skills are

available through our suppliers and they assist with implementation and re-skilling of our employees' (Man 03, Owner-Manager).

Even with formal university training, some SMEs continue to experience difficulties in getting the newly employed to apply their skills in a practical setting. An IT manager expressed the challenges faced in the following manner:

'...we have employees coming straight from college/university having done 3 years but have no idea what they are doing or ought to do. In the same token they are looking for a company phone etc. It just does not work...' (Log 02, IT Manager).

These findings bear resemblance to those in other sectors in South Africa as noted by Mpofu *et al.* (2010) in their study of e-business in South African SMEs. They concluded that owner-managers perceived training to be a costly investment especially for those employees that have never received any form of formal education. Owner-managers reported investment in upgrading in-house skills to be risky (i.e. trained employees are free to find new employment using the knowledge they have acquired). Similarly, Beckinsale *et al.* (2011) noted that the lack of internal expertise to ensure ICT use fit with business strategies was a major problem for SMEs.

Environmental context

The business environment in which firms operate has important implications for the way SMEs use ICT. We analyse three areas relating to the environment: Supply chain networks bring competitive pressures to adopt technology applications, ICT consultants and vendors use their interests and knowhow to shape ICT diffusion, and governments provide critical sources of infrastructure policy and regulation. All three factors play a significant role in the way in which SMEs benefit from ICT use.

Supply chain networks

Results illustrate that more than 50 percent of studied SMEs are in some form of regular trading relationship with large organisations, with a further 13 percent and 23 percent trading a few times a year with larger firms or once a year respectively. The Kruskal-Wallis coefficient of $p \leq 0.003$ shows a significant positive correlation between firm size and working relationship with large organisations (see Appendix 1 and 2). Also 32 percent (51) of SMEs report as being regular suppliers to large organisations. A further 22 percent are frequent suppliers followed by 16 percent supplying large organisations on a monthly basis. The Kruskal-Wallis tests ($p \leq 0.04$) show a significant positive correlation between firm size and relationship with large organisations, meaning medium-sized firms trade more and regularly with large organisations in this capacity (see Appendix 1 and 2).

Supply chain networks, in both developed and developing countries, have emerged as viable competitive tools for firms to exploit existing markets and for accessing new markets and technologies (Özcan, 1995a). SMEs are characterised as adaptable, hence through network relations, can compete and reach economies of scale through flexible specialisation. This study has shown that networks and supply chain involvement are useful conduits for SMEs to access new markets and technologies, and are essential for firm competitiveness (Özcan, 1995b; Beckinsale and Levy, 2004).

Consistent with these findings is the research study by Olawale and Garwe (2010) who suggested that networking can positively impact on the growth of South African SMEs. According to one owner-manager:

'We supply one major customer (BAE systems) and other smaller firms. We also buy from one major supplier of manufacturing machinery. We act mostly as a sub-contractor of large companies on a one-off basis' (Man 03, Owner-Manager).

The main implication for South African SME owner-managers is that a typical firm is more likely to improve its chances of achieving growth with networking practices or supply-chain involvement than without. ICT use is paramount in such supply chain relationships (Tan and Eze, 2013). However, the downside of such arrangements is that despite the stability they bring, they may also lead SMEs to become economically dependent on their larger partners for survival (Ramdani *et al.*, 2009), potentially leading to a situation we term 'supply chain slavery'.

ICT consultants/vendors

ICT consultants are often referred to as 'marriage brokers' (Bessant and Rush, 1995) or obligatory passage points that are supposed to provide cumulative knowledge (Pozzebon and Pinsonneault, 2012). Swanson (2010) indicated that ICT consultants can be seen as bringing various complementary capabilities that help clients (SMEs) innovate and adapt to the on-going challenges of doing business. In this regard, vendors and consultants can play an effective mediating role in the way SMEs use and benefit from ICT use.

About a quarter of the respondents indicated that pressure from ICT consultants/vendors was the most important factor influencing adoption with 55 percent indicating it as fairly important. Of the total respondents who claimed some sort of pressure from consultants/vendors, 52 percent are from the logistics sector. The fact that the majority of owner-managers in the logistics sector were of black ethnic background may explain why they may be forced to look for external help as they lack experience and have lower levels

of education as a result of Apartheid restrictions on the black majority. Of note is a fairly high indication by the SMEs (18 percent) who feel no pressure from ICT vendors. This represents the firms that have in-house ICT expertise, for example, those that developed their own ICT:

‘We develop our own systems in-house. We have very capable staff capable of implementation of both in-house ICT and those acquired off the shelf’ (Log 05, IT Operations Manager).

Other firms had highly trained ICT employees with the ability to choose ICT suitable for their firms (for example, Log 02):

‘We have a very strong IT department with highly skilled individuals. We are funded internally; no problems in this regard. Operationally, we fix most of the problems that may arise’ (Log 02, IT Manager).

Contrary to the findings by Ramdani *et al.* (2013) who found external ICT support to be insignificant, the general lack of ICT expertise in South African SMEs and especially in the logistics sector dominated by black owner-managers necessitated the need to engage external ICT providers and consultants to ensure that these firms benefited from their ICT investments. Indeed, intermediaries such as consultants and vendors played a crucial role in ensuring impact and value for money in these firms.

Government support

The role of the government in providing infrastructure and policy is indisputable. Having gone through decades of Apartheid rule, the South African government is expected to play a direct and pivotal role in facilitating an infrastructure that enables SMEs to compete and allow previously disadvantaged black majority to fully participate in the economy. However, findings show that 81 percent of the survey respondents (105 SMEs) report not

having received any financial support from the government in relation to ICT investments. These findings mirror the interview responses with owner-managers reporting very little support coming from the government, especially from white owner-managers who dominated the manufacturing sector:

'...no major support apart from the import allowances we get should we wish to import some machinery.' (Man 06, Marketing Manager).

'...only information regarding regulations, compliance and certification. No funding or other initiative assistance was received' (Man 07, General Manager).

These findings differ with those of Mpofu *et al.* (2010) who found the government to be playing a significant role in SMEs in the tourism sector. The differences may be due to the government drive in that sector ahead of the 2010 football world cup to bolster the tourism sector. Similarly, the Finmark Trust (2010) found on average 75 percent of small business owners in Johannesburg were not aware of government organisations that give support and advice. The owner-manager of Man 03 gave his view on the lack of support structures:

'...there is no support from institutions or any other organisation apart from the percentage VAT refund on machinery bought. The process for claiming VAT is simple as you can claim it immediately every two months (i.e. set-off what you owe against your refund)' (Man 03, Owner-Manager).

These observations indicate long standing problems with government schemes or support initiatives where red tape hinders beneficiaries from accessing needed resources. Critically though, the government is accused of interfering in the competitiveness of

firms. This is a result of the government's insistence that firms in the logistics sector should adopt specific technologies before operating licenses are issued. However, other firms, such as Log 03 (see excerpt below) viewed the government stance as delivering positive outcomes to business:

'...IT allows speed of task execution, access to information is quick and in front of you. I do not have to spend time travelling to customers, all work is done on-line: documentation, customer interaction and communication and goods clearing. Efficiency is at the heart of using IT platforms' (Log 03, Owner-Manager).

Policies and regulations affect every facet of SMEs more so than in large organisations. In many developing countries in sectors such as telecommunications, governments have maintained control of the industry (for example, Telkom in South Africa). While this was expected and practiced during the Apartheid era, surprisingly, even post-Apartheid South Africa continues with a telecommunications monopoly and this is viewed by some owner-managers as limiting full exploitation of ICT because of issues such as poor internet speeds, lack of bandwidth and high access cost. Though some analysts have claimed that deregulation has led to affordable communication and technology development in South Africa (Gillwald, 2005), many interviewees shared their dissatisfaction in relation to the services offered by the government owned telecommunications operator:

'There is a monopoly in the provision of the telecommunications infrastructure and services. Telkom has the rights of distributing or selling data capacity to various organisations. The price and capacity are very prohibitive, hence expensive for the firm in the long run'. (Log 02, IT Manager).

Furthermore, the government in its attempt to redress the economic inequalities of the past has pursued policies that seek firms to attain a particular classification to be eligible to bid for government contracts or tenders (Reddy and Rampersad, 2013). One such policy is the broad-based black economic empowerment (B-BBEE). It requires SMEs to have attained a particular classification on the B-BBEE score card system. This has not been well received by various SMEs:

‘The major problem that we have is compliance with government regulations and we feel there is a glass ceiling that has been imposed on us as SMEs. The B-BBEE regulations are very prohibitive. As a result we can operate to a certain level but cannot expand our operations as we are very limited in terms of the relationships we can create and engage in because of the certification requirements’ (Man 08, Owner-Manager).

Such policies have been criticized in relation to bids that have gone through using political connections and not on the basis of merit. Also, some firms seeking certification may claim that their secretaries, gardeners and drivers are directors in order to satisfy the regulatory authorities of a proportionate black representation in firms. Window dressing often takes the form of “black people that are listed as shareholders, executives, or management, but who are unaware or uncertain of their role or participation within an enterprise” (Lotheringen, 2012, pg. 1).

While such policies may have been aimed at driving the use and impact of ICT in SMEs, they also seem to have unintended consequences as seen above. Nevertheless, ICT use has been driven especially in the logistics sector due to government regulations requiring firms to use specific types of ICT applications. This has in turn resulted in positive business impacts for firms: for example, SMEs who have adopted mandated ICT have

been able to collaborate or even compete with larger foreign owned rivals like DHL and TNT Express and also with local firms as noted by Log 04 and also Log 06 who credit ICT with giving them a competitive edge:

'...easier communication via emails, ability to have real-time information about the location of vehicles and parcels. We have also been able to form relationships with larger organisations...' (Log 04, Owner-Manager).

'...fast/speedy execution of activities/production, risk minimisation, cost savings. We are able to enforce safety in our operations/drivers as we have monitoring data/ability, no more over spending, tracking trucks and hence remain competitive' (Log 06, Operations Manager).

These outcomes - competition and collaboration – can be seen as specific examples of strategic impact of ICT in South African SMEs.

Conclusion

In this article we investigated the adoption and impact of ICT by SMEs in South Africa's manufacturing and logistics sectors in the Johannesburg area by using the Technology Organisation Environment (TOE) model. The findings demonstrate that owner-managers' expertise and skills, ICT consultants/vendors involvement, supply chain characteristics and government policies are the leading factors that shape ICT adoption and thereby constrain and/or facilitate the business impact of ICT deployment in the firm. In particular, supply chain networks have emerged as both a driver and an effect of ICT use in the South African context albeit with some negative consequences. We found that supply chain capability can serve as a catalyst in transforming the competitiveness of the

firm but it can also take the form of ‘supply chain slavery’ if SMEs become dependent on their larger counterparts for survival and growth.

Increased sales and enhanced procedures for compliance with government regulations point to growing capacity of SMEs in benefitting from ICT. Another critical finding is that the government plays a catalysing role in encouraging the use of ICT through policy requiring firms to adopt specific technologies. This facilitates competitiveness of SMEs and their engagement in strategic collaborative relationships with larger firms. Hence, contrary to mainstream findings about ICT adoption and impact in SMEs, our findings in the South African context show a more mixed picture. Although firms are constrained by lack of expertise and often constrained by government policy, there are also many examples of strategic impact of ICT in the form of collaboration and even possibilities of competition with larger firms. This positive impact has been observed especially in the logistics sector. However, as we have shown here, the broad-based black economic empowerment (B-BBEE) policies have had unintended consequences and are not perceived as enhancing entrepreneurship and SME development. The study suggests that government’s ICT support and SME policies should better address critical areas such as capacity building, skill upgrading and norm setting at the level of regional economies and industries. In particular, the general lack of ICT capabilities and human capital as well as widespread ignorance of available policy mechanisms, especially among the black majority, needs to be addressed. Policy also needs to address the constraining effect of the telecoms monopoly on SMEs’ use of ICT.

The study shows that many South African SMEs are confident, mature users of ICT, with owner-managers engaged in ICT decision making alongside other senior managers. There is also evidence of a skills deficit in many SMEs, especially in the black-dominated

logistics sector. In both logistics and manufacturing sectors, firms with poor ICT capacity are often reliant on external assistance from vendors and consultants. There is ample opportunity here for government agencies to play a key role in offering targeted help to these firms.

This study has contributed to a better understanding of the adoption and impact of ICT in a developing country setting albeit with massive social disparities. The transition from a white minority rule and their economic domination to a more equitable system requires long-term planning and concerted policy making. Our findings can be used by policy makers to develop strategies that aim to increase the rate of ICT adoption among SMEs and especially for the previously disadvantaged black majority. Future research can build on the theoretical approach used in this study to offer a richer understanding of ICT adoption challenges and impact in developing countries. This study focused on an economically active geographical area, Johannesburg; hence caution must be exercised in generalising some of its results to other South African regions. Future studies could usefully explore ICT adoption and impact from a sectoral and cross-country perspective. Also, we believe one of the key limitations of this study is the inability to analyse the longitudinal impact of ICT adoption and use, such as the evolution of ICT functionalities and their value to these firms in a transitional economic context.

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Appendix 1 *Kruskal-Wallis Correlation Matrix*

	n=130*	Kruskal-Wallis Correlations						
		1	2	3	4	5	6	7
1	Annual revenue	1.00						
2	Age of the firm	.00	1.00					
3	Working relationships with large firms: Purchasing from large firms	.00	.55	1.00				
4	Working relationships with large firms: Supply chain	.04	.02	.00	1.00			
5	ICT compatibility	.06	.02	.00	.00	1.00		
6	Owner-manager level of education	.45	.41	.21	.77	.25	1.00	
7	ICT Satisfaction	.69	.76	.02	.72	.02	.00	1.00

*Level of significance ≤ .05

Source: Author

The Table above shows correlations identified using SPSS statistical software. Values of less than 0.05 ($p \leq 0.05$) assumed to signify a significant relationship. For example say owner-manager’s level of education vs ICT satisfaction ($p \leq 0.00$) means there is a positive correlation between these two variables. Appendix 1 and 2 below shows detailed statistics of the various relationships discussed in this paper.

Appendix 2 *Kruskal-Wallis Statistics*

Nature of Relationship	Sample size (130)	Degrees of freedom (df)	Chi-Square (X2)	Kruskal-Wallis Correlations
Age of the firm vs ICT Compatibility	127	2	17.87	.02
Owner-manager level of education vs ICT Compatibility	127	2	8.06	.02
ICT Satisfaction vs Owner-manager level of education	130	2	11.16	.00
Firm Revenues vs Age of the firm	118	3	15.56	.00
Firm Size (Revenues) vs Working relationship with large companies: purchasing from large companies	106	3	9.89	.00
Firm Size (Revenues) vs Working relationship with large companies: supply chain	109	3	11.30	.04

Source: Author

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