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A PERCEPTION-BASED MODEL FOR TECHNOLOGICAL INNOVATION IN SMALL AND MEDIUM ENTERPRISES

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Abstract

Small and Medium Enterprises (SMEs) form an integral part of every economy as they are the leading providers of revenue and employment. However, as the global economy becomes more reliant on Information Communication and Technology (ICT), some SMEs are yet to reap the benefits that ICT has to offer. The low rate of adoption and innovative use of ICT amongst SMEs has become significant research topics in recent times. One of the many contributing factors towards the above is the failure of SMEs to recognise ICT as a technological innovation, thus affecting their decision to adopt ICT. This and the lack of dynamism between ICT firms and SMEs further impede the development and innovation of ICT for SMEs. Using a technology-organization-environment framework, this study attempts to address the above issue by introducing a perception-based model for technological innovation in SMEs. The model is to be further tested against data collected from an Australian context. The model has both research and practical contributions. For research, the model attempts to study the key determinants and processes of technological innovation and ICT adoption in SMEs. Further, the model attempts to help SMEs recognize that adopting ICT as a technological innovation is important but more of an adaptive than a technical challenge.

Keywords: Small and Medium Enterprises, Technological Innovation, Information and Communications Technology (ICT).

1 INTRODUCTION

Small and Medium Enterprises (SMEs) are integral sources of revenue, employment and product innovation for the economic growth of a country. SMEs are generally characterized by a smaller workforce and lower turnover. Information and Communication Technologies (ICTs) can help SMEs create business opportunities and combat pressures from competition (Levy and Powell 2005; Kotelnikov 2007). Despite the obvious benefits, majority of SMEs do not readily adopt ICT, citing cost as the single biggest factor threatening future investments in ICT. This can be seen as to why SME owners have a very cautioned approach when it comes to making investments in ICT, particularly when they have difficulty quantifying the business benefits that might arise. Hence, many SMEs lack the ability to recognise ICT as a *technological innovation* that could provide competitive advantage to the adopting organization, in turn determining its survival (or destruction).

Extending the works of Rogers (2003), Thong (1999) and Tornatzky and Fleischer (1990), a perception-based model for recognising ICT as a technological innovation using a technology-organization-environment framework is developed and explained. According to Rogers (2003, p12), an innovation is *an idea, practice, or object that is perceived as new by an individual or other unit of adoption.* As Thong (1999, p190) adds: an innovation in ICT, is not only a renewal by means of technology, but it can also refer to renewal in terms of though and action. It is further envisaged that technological innovation comprises two related but distinct factions: (1) to find innovation in existing ICT and (2) if unsuccessful, a decision to adopt more advanced (ICT) innovations. In this proposed model, technological innovation is influenced by ICT use and the SME context - which comprises of perceived impacts of technology, perceived organizational readiness and perceived external environment. ICT use in turn is also influenced by the SME context. The model has important implications for both research and practice. For research, the model attempts to study the key determinants and processes of technological innovation and ICT adoption in SMEs. Further, the model attempts to help SMEs recognize that adopting ICT as a technological innovation is important and more of an adaptive than a technical challenge.

The rest of the article proceeds as follows: Firstly, the literature review provides a consolidated understanding of SMEs and how ICTs enables SME's to operate. To do this, the definition and characteristics of SMEs are examined. Based on these characteristics, the adoption trends, benefits and barriers of ICT in SMEs is next discussed. Next, the perception-based model for technological innovation in SMEs is introduced. The key dimensions and measures of the constructs in the model are explained. Lastly, the intent for future work is explained. The model is to be tested against empirical data to be collected in an Australian context.

2 LITERATURE REVIEW

2.1 Small and Medium Enterprises

The definition of small and medium enterprises (SMEs) varies from region to region[1]. The main criterions that predominate to define SMEs are the number of employees, turnover and the balance total (Burns, 2001). For example, the European Union (EU) define an SME as enterprises that employ no more than 250 employees, a maximum annual turnover of 40 million euros and a maximum annual balance sheet total of 27 million euros (Levy and Powell 2005, p20). According to the Australian Bureau of Statistics (ABS 2001) on the other hand, an SME is defined as business employing less than

[1] Besides the EU definition, other definitions include the OECD which considers SMEs to have no more than 299 employees. The US definition considers all firms employing fewer than 500 employees as SMEs. (Levy and Powell 2005, p20)

200[2] people. As of July 2006, close to 140 million SMEs in 130 countries employed 65 percent of the total labour force (World Bank, 2006). On average, they comprise over 95 percent of any economy (Kotelnikov 2007). The few other defining characteristics of SMEs are: (a) Independent ownership and operations, (b) Close control by owners/managers who contribute most, if not all the operating capital and (c) Principal decision-making by the owners/managers (ABS 2001).

Small and medium-sized enterprises (SMEs) are a very large heterogeneous group of businesses usually operating in the service, trade, agriculture, and manufacturing sectors. The sheer numbers of SMEs mean that they are an essential source of jobs. According to Ritchie and Brindley (2005), SMEs are significant because of their entrepreneurial spirit and adaptive capabilities. More importantly, SMEs are recognised for being the driver of economic growth and innovation and are crucial for fostering competitiveness (Levy and Powell 2005). Their knowledge allows them to innovate on the product or process, which helps them form a competitive advantage to generate more profits (Loh and Koh 2004, Kotelnikov 2007). While many SMEs are dynamic, innovative, and growth oriented, others are satisfied to remain small and family owned. The total number of SMEs in the economy depends on the rates at which SME are created and destroyed. When markets are profitable, the resulting opportunities increase the rate of SME creation. This increases the total number of SMEs in the country, which increases job creation and income per capita (Kotelnikov 2007).

From a more dynamic perspective, SMEs and larger organizations share a very close bond. This nature of this relationship can be described appropriately by a famous Chinese proverb widely adopted in literature: "*Chun Wang Chi Han*", when translated, literally means, "*When the lips are gone, the teeth will be cold*". This famous metaphor denotes that when one side of a close relationship is removed, the other is in danger. Most SMEs "exist to service the 1st and 2nd tier corporations (huge and fairly large enterprises respectively) or to provide specialty or outsourcing services to these corporations" (Huin 2004). In other words, SMEs also act as nurseries for the larger firms of the future (Gabriel 2005). They act as the next step up for expanding micro enterprises.

2.2 Adoption of ICT in SMEs

This section examines the ICT types, benefits trends and the barriers towards ICT adoption in SMEs. There is a range of ICT currently available to SMEs to adopt into their existing business. Kotelnikov (2007) separates the ICT into the following categories: (1) Basic Communication- the minimum ICT capability that any business should have, (2) Basic Information Technology - PCs accommodating word processing functionality, accounting and other business practices, (3) Advanced Communications – technologies providing the means for people to communicate and network with one another and (4) Advanced Information Technology – Generally consists of advanced packaged suites such as Enterprise Systems (ES) that consolidates a range of business applications for an organization's core of business processes (Shanks et al. 2003; McAfee 2006).

[2] A number of sub-categories are also defined within this sector: (1) Non-employing business – sole proprietorships and partnerships without employees, (2) Micro business – businesses employing less than five people, (3) Small business – businesses employing five or more, but less than 20 people and (4) Medium business – businesses employing 20 or more people, but less than 200. (Australian Bureau of Statistics 2001)

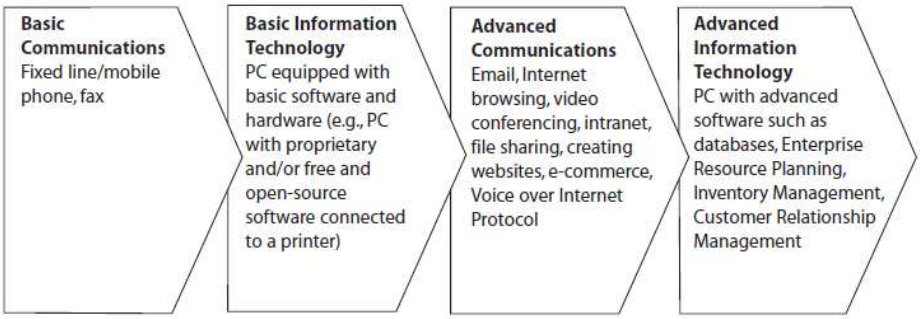

Figure 1: Gradual Progression of ICT adoption in SMEs (adapted from Kotelnikov 2007)

The benefits of ICTs are widely published. They provide mechanisms for getting access to new market opportunities and specialized information (Fulantelli and Allegra 2003). The adoption of appropriate ICTs will generally benefit most SMEs that adopt them by increasing productivity, increasing efficiency of internal business operations, and connecting SMEs more easily and cheaply to external contacts. Other benefits include increasing business competitiveness, vertical integration with other related businesses, stakeholders and institutions, networking with other parties etc (Levy and Powell 2005). Ion and Andreea (2008) categorized 27 benefits for ICT adoption for SMEs in the service industry into three dimensions: (1) *operational benefits*- including improved data management and response time, (2) *tactical benefits*- including improved planning times and integration with other business functions and (3) *strategic benefits* including market leadership and customer satisfaction. Stockdale and Standing (2004) further summarizes ten benefits (including product differentiation and supply chain entry) to be gained from SMEs participation in e-marketplaces.

Despite the rising reliance on ICT within society and their obvious benefits, SMEs are not utilising or investing in the available ICT to their competitive advantage. Most, if not all SMEs have some basic level of ICT capability but the number of organizations that have adopted advanced ICT (e.g. ES) is significantly low. For example, 90 percent of Thai SMEs still use basic communication technology such as fixed phone line and fax, and only one percent use CRM software (Kotelnikov 2007). According to Ritchie and Brindley's (2005), there is a corresponding lack of progress in Australian SMEs. Their findings were: (1) connectivity target was readily achieved, (2) few progressed beyond the second stage in adoption (trading online) and (3) very few achieved the e-business stage.

So what is affecting SMEs' decision to adopt ICT? Drawing from a number of sources including Kotelnikow (2007), Love et al. (2001), Ramsey et al. (2004) and Drew (2003), we examine the strategic, technological and organizational barriers to adoption and innovation with ICT. *Strategic* barriers relates to the SME management. SMEs, being smaller in size, leave the owners and managers of the SMEs to make strategic decisions. It is common for SME owners/managers with limited ICT literacy to have a stereotype that ICT is only for larger businesses. This stereotyping can lead to further lack of ICT financing options available. Given the already tight budgets of SMEs, ICT budgets (for initial ICT cost, maintenance and training) are usually small or nonexistent. Even if the SME has recognised the key benefits and have financial resources to integrate ICT into their core business, SME owners are often at a loss when needing to choose the most appropriate and cost-efficient product. The *technological* barriers of ICT adoption relates to the perception of the complexity of ICT. With a lack of ICT knowledge within the SME, the stereotype that ICT is too difficult and complex is seen as a reason not to adopt it. The lack of professional support available from ICT vendors to SMEs is another factor. ICT vendors tend to target larger companies as they have a larger budget and are typically more willing to pay for advanced ICT. This leads to a market with ICT products which are often not geared (i.e. too expensive and too complex) for SMEs. *Organizational* barriers relates to behavioural culture of the organization. Ramsay et al. (2004) asserts that it is 'well recognised that for SMEs to get the full benefit of the Internet and EB (Electronic Business), company and market structures may have to be re-invented'. It is noted in management literature that while ICT adoption and the changes it brings

may prove beneficial to the business in the long run, the changes will often result in weakening one department and strengthen another. For fears of job loss (Love et al. 2001) and reluctant to change the work practices (Drew 2003; Love et al. 2001), SME workers and owners are therefore reluctant to bring their business through a learning curve that may be prove to be difficult, disruptive and costly. Another key motivation for technological innovation is that the competitive advantage gained by the use of ICT can mean the survival of one SME business and the destruction of another.

2.3 Perceptions of the Technology- Environment- Organization Context

According to Tornatzky and Fleisher (1990), the process by which an organization adopts and implements technological innovations is influenced by the technological context, the organizational context, and the environmental context. These three elements present "both constraints and opportunities for technological innovation" (Tornatzky and Fleisher 1990, p. 154). Thus, these three elements influence the way an organization sees the need for, searches for, and adopts new technology. According to Tornatzky and Fleisher (1990), the *technological context* includes the internal and external technologies that are relevant to the organization. The *organizational context* includes characteristics and resources of the organization, including the organization's size and managerial structure. The *environmental context* includes the size and structure of the industry, the firm's competitors, the macroeconomic context, and the regulatory environment. Extending the TOE model: Based on SMEs highly centralized structures, where CEOs make most of the critical decisions, Thong (1999, p188) conceptualize and verified the importance of a fourth dimension (besides IS, organizational and environmental) with which IS is adopted: CEO's IS knowledge.

Mehrtens et al.'s (2001) Internet adoption model comprises three similar factors- perceived benefits, organizational readiness and external pressures. According to Mehrtens et al., perceived benefits are determined by efficiency, effectiveness and improved image in use of Internet. Organizational readiness for Internet adoption is personified in the SME owner and also determined by the adequacy of the infrastructure. And external pressure is primarily from customers, suppliers and employees.

Reflecting on the previous section, although it is important to study the determinants and effects of ICT as strategic tools for SMEs, there is further value in capturing on how stakeholders perceptions of the SME context and their use of ICTs influence the decision to invest in innovations or innovate in existing ICT. Although common sense, another motivation for capturing perceptions is the contextualized nature of technological, environmental and organizational factors (i.e. they vary from context to context). This is true for a wide spectrum of SMEs with varying definitions across regions.

3 A PERCEPTION-BASED MODEL FOR TECHNOLOGICAL INNOVATION IN SMES

Based on literature review and the works of Rogers (2003) and Tornatzky and Fleischer (1990), a perception-based model for technological innovation using a technology-organization-environment framework is developed. The model purports that three contextual factors (i.e. technology, organization and environment) affect technology use and technological innovation in SMEs. The model is depicted in Figure 2. This section examines the meaning of these constructs (or factors) and the hypothesized relationships between these constructs as depicted in Figure 2. The discussion includes the proposed operationalisation and the proposed *measures* of these constructs. Measures here are defined as "an observed score gathered through self-report, interview, observation, or some other means" (Edwards and Bagozzi 2000). Measures are quantifiable, for example, an empirical score gathered from a survey instrument (Freeze and Raschke 2007) used to examine a phenomenon.

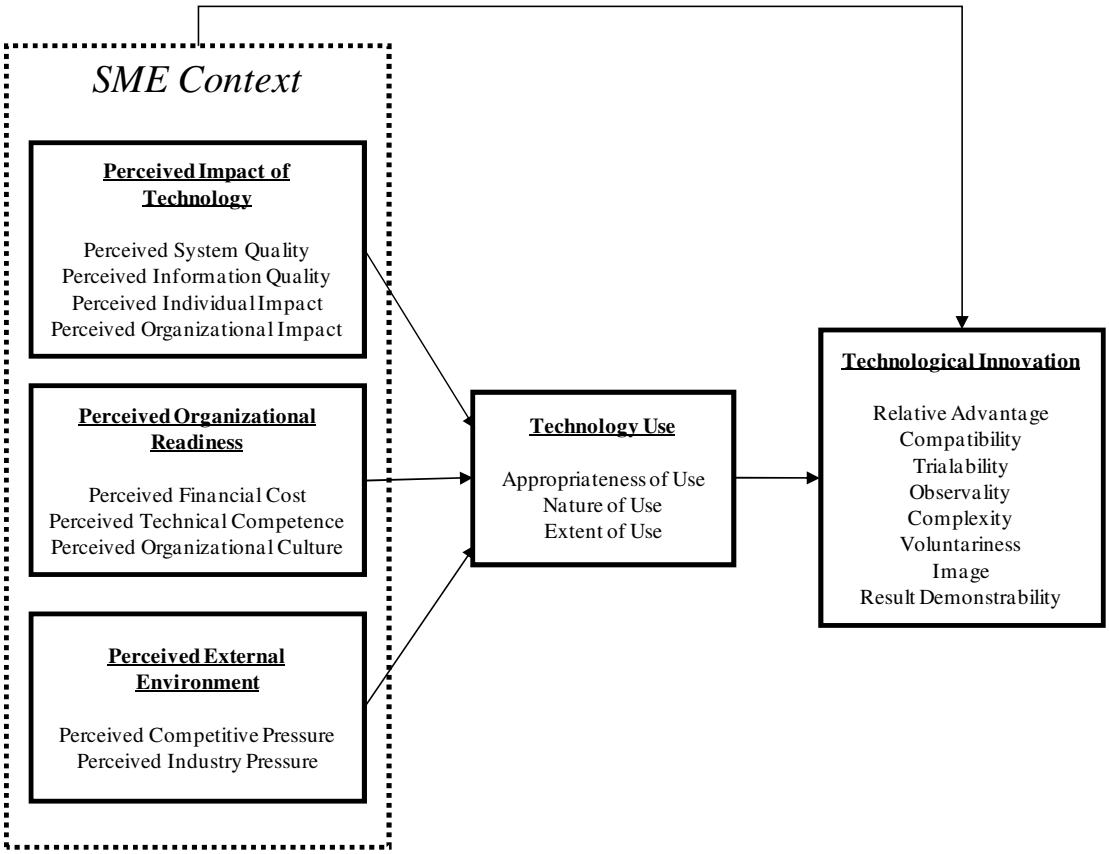

Figure 2: A Perception-Based model for Technological Innovation in SMEs

3.1 Technological Innovation

As earlier prescribed, this study adopts the seminal work of Rogers (2003), Tornatzky and Fleischer (1990) and Thong (1999) to define technological innovation. The *newness* of an innovation may be expressed in terms of knowledge, persuasion, or a decision to adopt. An ICT, as widely known has two components: (1) a *hardware* aspect that consists of the tool that embodies the technology as a material or physical object, and (2) a *software* aspect that consists of the information base for the tool (Rogers 2003). ICT is "*essentially a continuum of innovations which organisations need to adopt*" (Ritchie and Brindley, 2005). The widely cited Thong (1999) identified four dimensions of characterising technological innovations: nature, complexity, motivation and timing. A fifth dimension: source is added to this list (see Table 1). This addition follows the logical notion that technological innovations can either be bought or they could be developed in-house. It is viewed in this study that a technological innovation thus supersedes or presents itself as a superior alternative to previous practice of using ICT. It is further envisaged that an organization can pursue technological innovation in two related ways: (1) by discovering newness in existing ICT and if unsuccessful (2) adopting new and advanced ICT.

Dimension	*Characteristics*
Nature of Innovations	Process vs. Product
Complexity of Innovations	Radical vs. Incremental
Motivation of Innovations	Technology-push vs. Market push
Timing of Innovation	Planned vs. Incidental
Source of Innovation (new)	Internal vs. external

Table 1: Characteristics of an Innovation (adapted from Thong 1999)

In this study, a measure of technological innovation is determined by the perceived attributes of the technological innovation. The benefits of a technological innovation are not always clear cut to the intended adopters. And different technological innovations have different rates of adoption. According to Rogers (2003), individuals' perceptions of the attributes of an innovation, not the attributes themselves as classified objectively, affect its rate of adoption. Rogers (2003) introduced five empirically inter-related yet conceptually distinct attributes of innovations: (1) *relative advantage*- the degree to which an innovation is perceived as being better than the idea it supersedes (p 229), (2) *compatibility*- the degree to which an innovation is perceived as being consistent with the existing values, past experiences and needs of the adopters (p 240), (3) *complexity*- the degree to which an innovation is perceived as relatively difficult to understand and use (p 257), (4) *trialability*- the degree to which an innovation may be experimented with on a limited basis (p 258) and (5) *observality*- the degree to which the results of an innovation are visible to others (p258). Moore and Benbasat (1991) introduced and tested (on personal workstations) three additional attributes on top of the five proposed by Rogers: (6) *voluntariness*- the degree to which use of a technology is perceived as being an optional innovation-decision, (7) *image*- the degree to which use of a technology enhanced an individual's status in the organization and (8) *result demonstrability*- the degree to which a technology is easy to communicate with others. This set of attributes gives researchers a way to evaluate the technological innovation.

Hypotheses 1: Technological innovation in an SME is influenced by its perceived technological, organizational and environmental factors.

3.2 Perceived Impacts of Technology

According to Tornatzky and Fleisher (1990), the technological context includes the internal and external technologies that are relevant to the organization. Technologies may include both equipment as well as processes. Previously, Lacovou et al. (1995) and Kuan and Chau (2001) used direct (i.e. operational and financial savings) and indirect (i.e. impact on business processes and relationships) benefits to evaluate the ICT. This study proposes an alternate and somewhat broader approach. Gable, Sedera and Chan (2008) developed the Information Systems (IS)-Impact measurement model to capture at a point in time, the flow of net benefits, to date and anticipated, as perceived by all key stakeholder groups. To do this, the model employs four dimensions: *individual impact* and *organizational impact* (as measures of overall actual impacts to date) and *system quality* and *information quality* (as measures of the technology and probable impact). The model consolidates 27 measures for the above four dimensions that are classified into these two halves. In this study, it is perceived that impacts to date can be employed to capture perceived rather than actual impacts. It is purported that IS-Impact and its dimensions can be applied in this technological context to examine the level of recognition of the relative advantage that a technology can provide the organization.

Extending the measures of the IS-Impact measurement model, measures of perceived impacts of technology in SMEs consists of: (1) *perceived system quality*- captures users' perceptions of how well the ICT will perform from a design and technical perspective, (2) *perceived information quality*- captures users' perceptions on the quality of the task outputs that will be produced by the ICT in reports and on-screen, (3) *perceived individual impact*- captures how well the ICT will influence the users' performance and (4) *perceived organizational impact*- captures how well the ICT will influence the organization's performance. The measures adapted from Gable et al.'s (2008) IS-Impact measurement model are suggested in this study as they seek a broader and more qualitative benchmarking of the ICT, rather than relying on solely quantitative approaches.

Hypotheses 2a: The perceived impacts of technology are positively related to the technology use and technological innovation in an SME.

3.3 Perceived Organizational Readiness

The organizational context, according to Tornatzky and Fleisher (1990) refers to the characteristics and resources of the organization, including the organization's size, degree of centralization, degree of formalization, managerial structure, human resources, amount of slack resources, and linkages among employees. According to Ritchie and Brindley (2005), SMEs should be able to realise at a strategic level, benefits and long timescales involved, consequences of changing structures, processes and relationships for the business. They must more importantly, deal with a lack of IT knowledge, perceived complexity of systems. Perceived technological readiness thus captures beyond the technical complexities of ICT, but the organizational, social and behavioural complexities in the organization. Reflecting from the above, this study proposes three 'C's of cost, competence and culture as key determinants of organizational readiness for technological innovation.

Perceived financial cost consists of the financial resources required for ICT. Senior management must define a scope for technological innovation due to higher likelihood of inability to cope with budget blow-out. Management must be fully committed with its own involvement and have a willingness to allocate critical resources (Holland and Light 1999). This includes provision of required resources for the implementation and giving an appropriate amount of time to get the job done (Roberts and Barrar 1992). *Perceived technical competence* captures the technical skills of the stakeholders. SMEs must ensure availability of key resources, preparedness to adopt new technologies to tackle the limited ICT literacy of SME owners and employees. As much as possible within the SME, the ICT project team should consist of the best people in the organisation (Bingi et al. 1999). The team should have a mix of consultants and internal staff so that the internal staff can develop the necessary technical skills for design and implementation of ICT (in Figure 1) (Sumner 1999). *Perceived organizational culture* captures the structures of the SMEs. As earlier noted, SMEs consists of mostly owner-managers. Top management support is especially crucial for SMEs. Management should also have a strong commitment to use the system for achieving business aims (Shanks et al. 2003). However, it is also often the case that the employees refuse to adopt the new technology due to various reasons, such as dangers of job loss (Love et al. 2001) and reluctant to change the work practices (Drew 2003; Love et al. 2001). Thus, SME owners are often reluctant to bring their business through a learning curve that may be prove to be difficult, disruptive and costly. A clear business vision throughout the life cycle that outlines proposed strategic and tangible benefits, resources, costs, risk and timeline is thus critical (Wee 2000; Nah et al. 2001).

Hypotheses 2b: The perceived organizational readiness of SMEs is positively related to the technology use and technological innovation in an SME.

3.4 Perceived External Environment

Ritchie and Brindley (2005) contend that slow ICT adoption in SME is the result of more social and organisational issues, rather than technical or operational. The environmental context includes the size and structure of the industry, the organization's competitors, the macroeconomic context, and the regulatory environment (Tornatzky and Fleisher 1990). This study concentrates on two such factors: pressure from the *industry* and *competitors*.

Industry pressure in this study primarily focuses on external pressure from *customers*, through *suppliers*, and *regulatory bodies* associated with the industry. According to Poon (2000), customer pressure is influential and lack of customer use is an inhibitor towards ICT (such as internet and email) adoption. Standing et al. (2007) highlights the importance for SME managers to communicate effectively and maintain relationships with suppliers in an e-marketplace, to design a competitive business (procurement) structure. Stockdale and Standing (2004) further highlights the e-competence of the industry sector as a significant barrier to adoption and innovation. Lastly, countries where they operate also have an impact on IT and SMEs, because there are differences in available infrastructure,

economic development, government regulations, and cultures (Trimi 2008). There is evidence (from (Kowtha and Choon 2001) that some governments (for example Singapore) can increase SMEs potential for growth in ICT adoption, and have alternative funding policies to support these SMEs in their quest to prosper and add value to the country's economy.

According to Levy and Powell (2005, p240), a competitor is a firm that "*leads customers to value your product less when you have the competitor's product than when they only have yours*". The competitive environment in which the SME operates affects its chances of survival. Many SMEs are highly influenced by market uncertainties, operate in a classic perfect competition and tend to be price-takers (Storey and Sykes 1996). On the other hand, competitors can also benefit the operations of an SME through *co-opetition*- the recognition that firms may benefit in terms of knowledge sharing, from working together (Brandenbuger and Nalebuff 1996). Under co-opetition, what to share, with whom, when and under what conditions is thus important. According to Levy and Powell (2005), *synergy* (i.e. co-opetition yields greater knowledge than the sum of the participants), *leverage* (receiver yields greater knowledge*)* and *negative reverse impact* ("Sender's" knowledge is lowered as a result of co-opetition) are relevant topics to discuss in co-opetition.

Hypotheses 2c: Perceived external environment is positively related to technology use and technological innovation in an SME.

3.5 Technology Use

Effective use of ICT has enormous potential for returning business value and helping SMEs to achieve business aims. However, someone may have known and used the ICT for a long time but they may have not yet developed a favourable or unfavourable attitude toward it or has used it properly (Rogers 2003). Use is not only widely employed but often scrutinized in IS research. Use is widely criticised for being poorly defined and poorly measured. Although it is only logical that use varies across study contexts, attempts to define use in these contexts have been mostly arbitrary. DeLone and McLean (1992) define use as the receipt consumption of the product of the IS. Straub et al. (1995) define use, on the other hand, as: 'the utilization of information technology (IT) by individuals, groups or organizations.' Burton-Jones and Straub (2006) defines use as an activity which involves, besides a user and a system, the task- the function being performed. Sabherwal (2006) defines use as 'the individual's behaviour of, or effort put into, using the system.' In similar light, Petter et al. (2008) elaborates that use describes the degree and manner in which staff and customers utilize the capabilities of an IS. Reflecting on the above, for the complex state of systems today, prior notions of use are still largely inadequate. In a similar light, and referring to editor's comments in Lee (2000), researchers should look at IS use as involving more than just a physical and passive application of the system, but the consideration of tasks, users, information and organizational functions. Use of IS encapsulates both a passive task and an active state of interaction for acting on the task. From this, a broader, more systematic definition of technology use is thus envisaged: *The manner and degree that a user interacts with an ICT whilst achieving his tasks.*

The manner captures the nature of use, including its appropriateness. For example, the manner of use of ES expected of the users are no doubt different from other more basic ICT (as shown in Figure 1) and they reflect the goals of more contemporary applications such as Enterprise Resource Planning (ERP): (1) to automate and integrate business processes, (2) to share common data and practices across entire enterprise and (3) to produce and access information in a real-time environment. This study purports three distinct measures of use: (1) *Appropriateness of use* thus captures and compares the user's perceptions during use with the intended values and goals of the ICT. (2) *Nature of use* captures the types of uses that the user is using the ICT for. (3) *Extent of use* captures the widely adopted frequency and duration of use.

Hypotheses 3a: Technology use is positively related to the extent of technological innovation. And the more the user uses the system, the more he is likely to find innovative uses for it.

Hypotheses 3b: Technological innovation in an SME is influenced by technology use.

4 FUTURE WORK AND CONCLUSION

This section summarizes the future intent of this study. A phased approach to validating the perception-based model for technological innovation in SMEs is proposed. A mixed-method data collection that includes a qualitative interview and a quantitative survey underpins the phased approach. The approach comprises of two distinct yet inter-dependent phases: model specification and model confirmation. The phases and the associated activities are depicted in Figure 3. The purpose of the model specification phase is to identify the empirical context, and to specify the constructs and measures pertinent to the context. The objectives of the approach are in similar vein conceptually, to those of the two phased approach purported in Burton-Jones and Straub (2006) for selecting relevant measures for its intended measurement constructs. The purpose of the second phase, model confirmation is to test the model specified against empirical data collected.

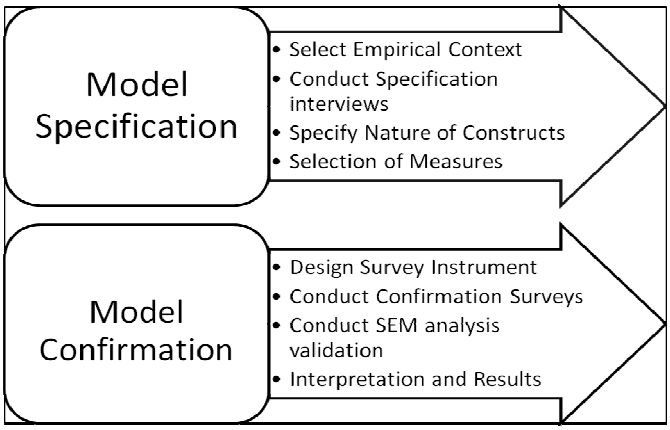

Figure 3: A Phased Approach to Model Validation

4.1 Model Specification

In the model specification phase of the study, the focus is on specifying the nature of the constructs and the relationship with its measures, based on the empirical context identified. As earlier determined, this model is to be tested against data collected from an Australian context. That is, the definition of the regulatory bodies, the technological competence of SMEs, the advanced (enterprise) systems available and the demographics of case organizations in Australia must be carefully defined. Enterprise Systems is chosen as the unit of analysis (Pinsonneault and Kraemer 1993) as it represents the epitome of advanced ICT. The study of ES geared for SMEs in the region (Australia and New Zealand) is still immature, but recent work on implementation factors of various ES vendors and their products (including Microsoft Dynamics NAV and SAP suite) in New Zealand is cited in Mathrani and Viehland (2009). A specification interview with key stakeholders (i.e. owner-managers) in the SMEs suffices the above objectives in this phase. Results of the interview would help to determine the relevant constructs and how to measure them.

The examination of formative vs. reflective nature of constructs in a model has also drawn recent attention in IS literature. This interest follows the popularity of structural equation modelling (SEM) techniques for assessing the (a) relationships between constructs and (b) relationship between constructs and measures. Recent revelations in marketing research further highlighted issues of measurement model misspecification and suggests that empirical findings reported in many IS literature may be misleading (Petter et al. 2007). Measurement model misspecification occurs when

researchers do not pay attention to the directional relationship between measures and the construct (Chin 1998). In a reflective model, the direction of causality is from the construct to the measures. On the other hand, a formative measurement model depicts a construct as an explanatory combination of its measure variables (Diamantopoulos and Winklhofer, 2001). It is thus important for us to pay attention to the conceptualization of the key constructs in terms of its reflective or formative nature, to add to their definition and subsequent validation.

4.2 Model Confirmation

This section examines the proposed method of the empirical data collection. Based on the results of the model specification phase (i.e. to capture what people think about the factors and constructs of technological innovation), a confirmatory survey of large representative groups in the SME can be developed. Surveys (Newsted, Huff and Munro 1998) are an appropriate method for a study of this nature as they: (1) allow us to determine the values and relations of the factors influencing SME technological innovation (2) can be reused easily to provide an objective way of comparing responses between SMEs (3) can be generalized and be used to predict SME behaviour. The important considerations at this phase for a study of this nature includes the canvassing of different stakeholders of the SME, a longitudinal survey approach to gather responses from multiple points in time and a smaller sample size. As earlier mentioned, structural equation modeling (SEM) techniques for assessing the (a) relationships between constructs and (b) relationship between constructs and measures will be employed. Statistical analysis are expected to support (or not) the hypotheses derived and explained in the earlier section (three). Results should also validate other auxiliary hypotheses such as: technology use has a mediating effect on the relationship between SME context and technological innovation.

4.3 Conclusion

SMEs are an integral part of every economy and are the leading providers of revenue, innovation and employment worldwide. For those that adopt them, ICTs assists SMEs in building a competitive advantage. However, the global uptake and adoption of advanced ICT systems is low. Although most SMEs already have ICT installed in their business, it is generally very basic. Furthermore, SMEs are generally reluctant to pursue or allocate adequate resources for technological innovation. This is largely due to a lack of SME demand for advanced ICT systems, failure of business-oriented owner-managers to recognise the value in installing an advanced ICT system and a general lack of product availability for the SME market. Using a technology-organization-environment framework, this study attempts to address the above issue by introducing a perception-based model for technological innovation in SMEs. The model is to be further tested against data collected from an Australian context and for enterprise systems, the epitome of advanced ICT. The model consists of five key constructs and purports those three contextual factors: (1) technology, (2) organization and (3) environment- affect technology use and technological innovation in SMEs. The model has both research and practical contributions. For research, the model attempts to map the key determinants and processes of technological innovation and technology adoption. Further, the model attempts to help practitioners recognize that adopting ICT as a technological innovation is more of an adaptive than a technical challenge.

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