The Use of E-Business in Agribusiness: Investigating the Influence of E-Readiness and OTE Factors

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ABSTRACT

This study explores antecedents to sector based e-business use. Sectoral e-business studies are valuable to understand the absorption of e-business in different economic sectors, the specific challenges of using e-business across different sectors and the potential of different sectors to integrate into the global digital value chain. Drawing from the perceived e-readiness model (PERM) and the Organizational, Technological and Environmental (OTE) framework, an integrated e-business use model is proposed. Data were collected from a survey of firms in the horticulture sector in Australia. Empirical analysis of the integrated model show that e-business use within the horticulture sector is at the initial state of maturity. In terms of the antecedent factors, this research shows that technology competence, financial commitment, perceived environmental e-readiness and organizational size are influential factors that directly affect e-business use. Perceived organizational e-readiness has an indirect influence on e-business use. The implications of these findings to both global IT management and e-business research are discussed. Practitioners such as governments, horticulture associations, growers and growers associations and digital marketplace operators, through understanding these factors affecting e-business use, can make effective decisions to develop their support, capabilities and offerings respectively.

KEYWORDS

E-Business Use, TOE, E-Readiness, Agribusiness, Horticulture

INTRODUCTION

Although the volume and value of transactions on the Internet is still on the rise, the infusion and use of e-business in different sectors of an economy remain uneven (Udo et al, 2008; Travica et al, 2007). Therefore, second generation e-business studies have

focused on sectoral absorption of e-business, the specific challenges of using e-business across different sectors and the potential of different sectors to integrate into the digital value chain (Zhu and Kraemer, 2005; EC, 2008). For instance, the European Commission, under the banner of "sectoral e-business watch", has been undertaking a series of e-business sector studies (EC, 2008). Notably missing from the European Commission sectoral studies list is Agribusiness. In view of various governments' (such as Australia's "Ex-Doc" and Canada's "Adding E-business to your Agri-business") and international organizations' (such as United Nations' e-agriculture) initiatives and the global socio-economic importance of agribusiness, there is a need for knowledge on how e-business practices are used in agribusiness and the antecedent variables that either facilitate or inhibit use.

Agribusiness covers activities involved in the production, processing, marketing and distribution of food and fibre products (Cameron, 1996). In the context of the global food crisis and escalating food prices, agribusiness' ability to improve efficiency and productivity can influence global peace and world order. Some previous studies have investigated the use of digital technologies and e-business to enhance the efficiency and performance of global agribusiness (Clasen and Mueller, 2006; Montealegre et al, 2004; Martin and Sellitto 2004; Pollard, 2003). While these studies have contributed to understanding some of the issues of e-business management in agribusiness, a number of gaps that motivated the current study exist. First, studies tend to focus on the potential of digital technologies in addressing some of the causes of agribusiness' inefficiency. Clearly, there is a need for empirical examination of the extent to which agribusinesses have translated e-business's potential to investment and real benefit. Second, the empirical evidence on the adoption of digital technologies in agribusiness is generally limited to case studies. A related issue is the lack of applying relevant theories to guide studies. Third, most studies have focused on the adoption of a single technology such as the Internet and the Web. There is a need for research that goes beyond a single technology and unravels how the technology has been assimilated in managing business relationships, in sharing information across the business network and in supply chain coordination and execution.

Therefore, in an attempt to address the gaps identified in the current literature, this paper addresses the following four questions: (1) what is the extent of e-business use in agribusiness (2) what framework can be used to study the antecedents of e-business use amongst agribusinesses? (3) based on the framework, what factors influence the

use of e-business amongst agribusinesses? and (4) what lessons can be drawn from this agribusiness sector e-business study?

To address the research questions a conceptual framework is developed and tested using survey data from 92 Australian horticulture supply chain firms. The Australian horticulture sector is chosen for a number of reasons. First, Australia is a leading exporter of agricultural commodities and horticulture is one of the major agricultural industries. Thus, the experience of Australia's horticulture sector can be taken as an important indicator of the experiences of other OECD countries. Second, long before the Internet, horticulture has been one of the early adopters of electronic trading mechanisms for auctioning flowers, for citrus fruits and for exchanging other horticultural products (Montealegre et al, 2004). This sector therefore provides a unique setting to understand the importance of historical advantages in Internet-based e-business.

INDUSTRY BACKGROUND

Horticulture, which comprises fruits, vegetables, nuts, nursery, extractive crops, cut flowers and turf, is one of the major agricultural industries in Australia. In addition to growers, the horticulture supply chain includes production, harvesting, post-harvest, logistics and marketing service providers and industry associations. It is an AU$ 7 billion industry, with an export value of more than 800 million comprising of 18,000 enterprises, employing 80,000 people (HAL, 2008). Horticultural establishments comprise approximately 16% of all Australian agricultural enterprises. In social terms, these enterprises shape the livelihood of rural Australia and affect rural communities' ability to respond to environmental challenges.

The Australian horticulture sector has a long tradition of export focus. However, it is also characterized as inward looking where most of the investments focus on the production end with less investment on the marketing and distribution end of the supply chain (Cameron, 1996). The new trend for more customization of agricultural products and their trackability and traceability in the farm-to-retail chain necessitates effective sharing of information amongst the members of the horticulture supply chain (Trevarthen, 2007). E-business offers agribusiness opportunities to address some of these challenges (Bryceson, 2006). However, a number of factors can influence the extent of e-business utilization. The following section reviews background theories and develops the research framework.

THEORETICAL PERSPECTIVES

A number of studies have investigated the organizational adoption of IT by developing empirical research models that are based on a wide variety of perspectives, such as the technological perspective (Rogers, 1995), managerial perspective

(Damanpour and Schneider, 2006) and the organizational perspective (Orlikowski, 1993).

Technological perspective frameworks address the technological related determinants of the adoption and diffusion of innovations. For instance, Diffusion of Innovation (DOI), focuses on the characteristics (or perceived characteristics) of an innovation such as relative advantage, complexity, compatibility, trialability, and observability (Rogers, 1995). Managerial innovation models underscore that the adoption of new technologies depend on managers' awareness of problems and on organizational culture that encourages risk taking (Damanpour, 1991). Studies also indicate that senior managers could systematically influence the content and characteristics of organizational activities (Damanpour and Schneider, 2006). The literature further identifies antecedents such as organizational size, complexity, sector and availability of slack resources to technology adoption (Orlikowski, 1993, Damanpour, 1991).

Some of these perspectives have also been used in previous studies that have investigated Internet and Web adoption in agribusiness. For example, Pollard (2003), explored the impact of a government-sponsored e-services program to improve communication activities of farmers in rural Australia; Bryceson (2003) identified the impact of e-business on the peanut industry in Queensland, Australia; Trevarthen (2007) explored the use of RFID on enhancing total farm management in dairy farms in Australia; Volpentesta and Ammirato (2007) evaluated web interfaces of B2C e-commerce systems for agrifood products; Ng (2005) developed a preliminary framework for Australian agribusiness organizations seeking to select business-to-business (B2B) e-business models; Martin and Sellitto (2004) explored the knowledge dimension of e-business models in Internet adoption amongst Australian wineries; Stricker et al (2003), discussed the situation of agricultural ICT in Germany; and Clasen and Mueller (2006) identified the success factors for digital marketplaces in the agribusiness sector.

From the review of existing innovation, IT and e-commerce adoption literature, the *organization-technology-environment* (OTE) framework (Tornatzky and Fleischer, 1990) and the *perceived e-readiness model (PERM)* (Molla and Licker 2005a, 2005b) are comprehensive enough for unifying the four key domains of e-business adoption and use, that is, technology, managerial, organisational and institutional. OTE posits that the technological (internal and external technologies), organizational (firm size, scope, centralization, complexity, slack resources) and environmental (industry and competitors) contexts of a firm can either facilitate or inhibit the acceptance and use of a given technological innovation. PERM, on the other hand posits that Perceived Organizational E-Readiness-POER (awareness, commitment and the stock of e-business resources) and Perceived Environmental E-Readiness-PEER (the readiness of market forces, government, and other supporting industries) are critical in a business's decision to adopt and institutionalize (use) e-commerce (Molla and Licker

2005a, 2005b). A number of studies have tested both OTE (Xu et al, 2004; Zhu and Kraemer, 2005; Mishra et al, 2007) and PERM (Dada, 2006; Lai et al, 2006; Tan et al, 2007) and demonstrated their usefulness for studying e-business adoption and use. PERM has also been applied in the agrifood sector (Volpentesta, & Ammirato, 2007).

THE CONCEPTUAL MODEL AND HYPOTHESES

The conceptual framework for the current study is developed based on the Organization Technology Environment (OTE) framework and the Perceived E-readiness Model (PERM). While OTE helps us to identify static contextual variables, PERM is useful to capture dynamic readiness dimensions. The integrated model is depicted in Figure 1 and each of the key concepts and the postulated relationships are discussed next.

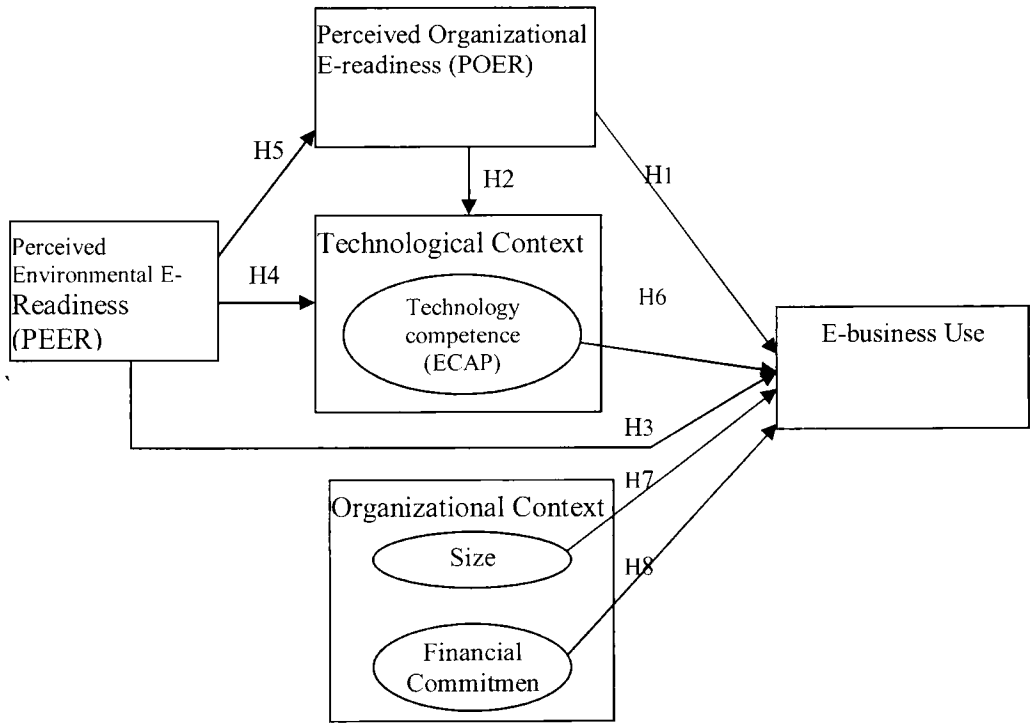

Figure 1. An Integrated Model of E-business Use in Agribusiness

E-business Use

The dependent variable in Figure 1 is e-business use. It refers to the use of the Internet and other information and communication technologies (ICTs) to conduct

business transactions. Thus defined, *e-business use* can be conceptualized to contain two areas: customer-oriented e-business use and business-oriented e-business use (Swaminatha and Tayur, 2003). Customer-oriented use includes providing customers with information, products and services in the business-to-customer domain. Business-oriented use consists of inter-business communication, coordination and collaboration among enterprises and between a government and businesses. E-business can be used in many of the customer and business oriented activities of the Horticulture Supply Chain.

Although horticultural products are not suitable for direct on-line selling, most growers, grower associations, logistics providers and exporters have established their own websites. Nevertheless, the functionality of the website might vary amongst supply chain members and in terms of the specific nature of the online informational capability. For instance, the Australian Horticulture Exporters Association hosts a list of exporters and other logistics providers with a link to their websites. For those that have not generated their own catalogue, it plays an infomediary role of broadcasting trade opportunities through its member update services. A few logistics providers offer online access to their services. An example is P&O's ePORTS. ePORTS is an on-line information service for P&O Ports customers that allows them real time access to information on vessel movements, container status, export commodity codes, and import and export delivery times. Ex-Doc, an Australian federal government e-business initiative allows horticultural exporters to electronically file health and/or phytosanitary documentation with the Australian Quarantine Inspection Service (AQIS) in order to gain export certification. An On-farm IT system, such as phytomonitoring, allows real-time monitoring of the growth and climatic conditions of agricultural products (Ton et al, 2001). Therefore, *e-business use* can be assessed by the breadth of use for horticulture supply chain information exchange, sense, monitoring and tracking, supply chain execution and supply chain co-ordination and collaboration activities.

Perceived Organizational E-Readiness (POER)

POER refers to an organization's capability in terms of e-business awareness and commitment and resources for successful e-business implementations (Molla and Licker 2005a). Awareness refers to agribusinesses' perception and comprehension of the benefits and risks of e-business. E-business is ideally suited for trading in digitised goods and services. Agribusinesses mostly deal with physical products and their knowledge of how to apply ICTs to trade with less effort influences their e-readiness (Mueller, 2001). The physical nature of agricultural products, absence of uniform and widely accepted product standards and grades, the traditionally low information intensity of the agribusiness sector might dissuade managers from investing in e-business (Montealegre et al, 2004). Thus the *commitment* of the owner/manager is critical to any innovation decision and its implementation. In addition, horticulture

firms need to have the know-how and capabilities to adequately manage their e-business projects; to build e-business technical infrastructure; and to use it in their business routines (Montealegre et al, 2004). Organizational e-readiness is therefore essential for developing technological resources and assets and for using those resources for conducting e-business activities. This implies that the linkage between POER and e-business could be either direct or mediated through the technological competence of the organization. This leads to the following two hypotheses:

> *Hypothesis 1: Firms with greater organizational e-readiness are more likely to achieve a greater use of e-business*
>
> *Hypothesis 2: Firms with greater organizational e-readiness are more likely to build higher technology competence*

Perceived Environmental E-Readiness (PEER)

The readiness of a firm to conduct business electronically depends not only on its own efforts, but also on the readiness of the market and institutional environment. PEER refers to a firm's assessment of the readiness of its customers, competitors, suppliers and regulatory and technological support (Molla and Licker 2005a). The relationship between PEER and e-business use can be both direct and indirect. While the direct relationship has been explored in previous studies, the indirect ones are new to this study.

In terms of direct influence, e-business (Zhu and Kraemer, 2005) and Internet use (Xu et al, 2009) studies have shown that competitive pressure and government encouragement can stimulate e-business use. E-business can flourish in an environment where that ICT industry provides solutions that are both affordable and relevant to agribusiness (Pollard, 2003). Government's commitment to facilitate both the regulatory institutions and the development of rural ICT infrastructure can play a significant role in making e-business use an attractive proposition for agribusinesses. This leads to the following hypothesis:

> *Hypothesis 3: Firms that perceive higher environmental e-readiness are more likely to achieve a greater e-business use*

In terms of indirect influence, a firm's assessment of the e-readiness of its external environment is likely to trigger organizational actions that aim to improve a firm's technological capability and organizational e-readiness. Producer associations often wield a great deal of influential power in relation to the practice of commerce in agribusiness markets. In addition, businesses whose main rivals and customers are engaged in e-business can find themselves under market pressure to improve their technological base and organizational e-readiness for e-business use. Institutions such

as government and professional and industry associations can influence a firm's e-readiness either formally (through direct subsidies, loans or incentives) or informally (through norms and rules that encourage use of e-business). Trevarthen (2007) shows that regulations that enforce traceability, such as Australia's National Livestock Identification System (NLIS), can motivate agribusinesses to adopt latest e-business technologies such as RFID that not only comply with NLIS requirements but also provide farm management benefits. Support-giving industries that develop e-business solutions applicable to a particular domain and their cost structure can also affect e-readiness. The above leads to the following two hypotheses:

> *Hypothesis 4: Firms that perceive higher environmental e-readiness are more likely to achieve better technological competence*
>
> *Hypothesis 5: Firms that perceive higher environmental e-readiness are more likely to demonstrate greater organizational e-readiness*

Technology Context

E-business use is likely to flourish in horticulture firms that have developed some technological capability. A number of e-business and e-enabling technologies that are relevant in the horticulture supply chain exist (Bryceson, 2006: Trevarthen, 2007). These technologies can be classified into four categories: *farm automation, Internet, e-supply chain and mobile and wireless technologies*. Farm automation technologies can provide real-time information in pre-harvest maturity monitoring, ripeness determination and post-harvest treatment of agricultural products (Ton et al, 2001). Internet technologies such as broadband and Websites enable firms to communicate, interact, and transact with their trading partners. E-supply chain technologies such as Internet-enabled tracking and cold-chain systems, electronic document interchange, bar-coding and global positioning systems facilitate accurate ordering, delivery and invoicing, which are essential to an industry's profitability. Mobile technologies and short messaging service (SMS) are important tools for sharing market and other horticulture specific critical information.

Within the context of OTE and based on Zhu and Kraemer (2005), the technology context is operationalized through *technological competence.* In this study, technological competence refers to a horticulture firm's accumulation of farm automation, Internet, e-supply chain and mobile and wireless technologies. Firms that have invested in e-enabling technologies are likely to use those to digitize their value chain processes and functions. The above leads to the following hypothesis:

> *Hypothesis 6: Firm's with higher technology competence are likely to make more use of e-business*

Organizational Context

Organizational context refers to the descriptive properties of a business such as sector, size and budget allocation. The horticulture supply chain is an open and highly complex environment. The value chain is archetypically dominated by family-owned small farmers. Small size restricts access to relevant human and technological *resources*. For example, Stricker et al (2003) opined that the ICT resources of most farmers are not different to those of private households. On the other hand, smaller firms tend to be structurally less complex than larger firms and may be able to quickly change their internal processes and structures in order to build e-business capability (Daniel & Grimshaw, 2002). The effect of firm size on e-business use could be a mix of structural inertia and competitive pressure. The structural inertia associated with large firms appears to retard their internal e-business preparation (Xu et al, 2004). On the other hand, large firms might feel the competitive pressure and the need to develop e-business capabilities as their competitors engage in e-business. Similar to Zhu and Kraemer (2005), the following is hypothesized:

> *Hypothesis 7: The smaller the size of a horticulture firm, the higher the extent of e-business use*

Agribusinesses are characterized by investing more on the production end and less on the marketing and distribution end of the agribusiness chain (Cameron, 1996). Most struggle to be competitive and usually receive subsidies (O'Keeffe and Mavondo, 2005). This implies that availability of financial resources for e-business is likely to be a challenge. Financial resource, on the other hand, is one of the important factors in influencing innovation. Similar to Zhu and Kraemer (2005), focusing on the financial resources that a horticulture firm commits to information technology, the following is hypothesized:

> *Hypothesis 8: Firms with greater financial commitment to information technology are more likely to use e-business to a greater extent*

RESEARCH METHODOLOGY

Operationalization of Constructs

The conceptual model is composed of seven major constructs. E-business use (EUSE) is assessed using 13 items derived from a review of the literature. Technology context (ECAP) is instrumented by counting (Zhu and Kraemer, 2005) the adoption of ten technologies that are relevant to the horticulture sector identified from key informant interviews and Bryceson (2006). In terms of organizational context, firm size (SIZE) is measured using employee numbers and financial commitment (ITSP) is assessed by taking the ratio of IT spending to total revenue (Damanpour and Schneider, 2006; Zhu

and Kraemer, 2005). Perceived organizational (POER) and environmental (PEER) e-readiness are adapted from Molla and licker (2005a). See Appendix 1 for the questionnaire.

Data Collection

The sample for data collection covers horticulture growers, associations, pre- and post-harvest service providers, marketing service providers, wholesalers and retailers. A total of 1335 potential respondents were identified from a database leased from a commercial database provider, through Web searches and from members of the Australian administrator for global supply chain standards. The data were collected using a questionnaire addressed to the CEO or their equivalent during September-October 2007. After four weeks of the initial mail out, over 450 follow up phone calls were made to randomly selected addresses from the sample frame. On the sixth week, e-mail reminders were sent to over 500 respondents. Of the 1335 mailed out questionnaires, 40 bounced back as undeliverable because of business closure, address change or CEO change. Of the delivered questionnaires, 101 replied giving an 8% response rate. Nine were incomplete or had too many missing data points and were therefore excluded from the analysis, leaving 92 usable responses.

To estimate the presence of non-respondent bias, early respondents were compared with late respondents, especially those that responded after reminders were sent out (Armstrong and Overton, 1977). Accordingly, the responses of the first 20 respondents were compared (using Mann–Whitney test) against the last 20 respondents. The result shows that there was no significant difference between the two groups except item ORGF1: U=121.00, z=-2.21, exact p(2-tailed)=0.028, r=-0.35. This implies that, even if non-response bias cannot be completely ruled out, it is not significant.

Most of the respondents (84%) were general managers or their equivalent (such as Managing Directors, Chief Executive Officers, or Owners). The businesses have been operating on average for 28 years. Fifty two percent of the firms grow fruit, vegetables, plants and cut flowers. Summary information of the respondents is presented in Table 1.

Table 1. Summary of firms in the sample

Business age (years)	No. of respondents	Percentage
<= 10	17	18%
11---25	33	36%
26-- 50	24	26%
51--100	7	8%
>101	2	2%
Missing	9	10%
Sector[1]	No. of respondents	Percentage
Fruit Growers		
Vegetable growers	46	50%
Plant nurseries	9	10%
Cut flower and flower seeding	12	13%
Production and harvesting service	4	4%
Post-harvest and logistics	16	17%
services	12	13%
Marketing services	16	17%
Wholesale/retail	12	13%
Horticulture associations	10	11%
Business employee size (full time equivalent)	Number	Percentage
Micro (<=4)	33	36%
Small (5-19)	34	37%
Medium (20-99)	3	3%
Large (>=100)	1	1%
Missing	21	23%

INSTRUMENT VALIDATION

The reliability and validity of the instrument was evaluated using factor loadings with principal component analysis (PCA) for the constructs of e-business use, POER and PEER. The result is summarized in Table 2 and indicates that all constructs are reliable (α>0.7) and that there is no multicollinearity issue among items (determinant>10^{-5}).

[1] Note that since some businesses operate in more than one category, the total is more than 92.

Table 2. Reliability and validity of the measurement model

Variable	Item	Factor Loading	R^2	Cron-bach's α	Other validity tests
E-business Use (EUSE)	EBUF12	0.723	0.743	0.824	KMOMSA=0.723 Bartlett's test= χ^2 (66)=386.431at p=0.000 Determinant= 0.10
	EBUF2	0.718	0.505		
	EBUF11	0.685	0.478		
	EBUF13	0.625	0.685		
	EBUF1	0.603	0.457		
	EBUF7	0.576	0.490		
	EBUF10	0.569	0.420		
	EBUF8	0.561	0.408		
	EBUF4	0.533	0.379		
	EBUF3	0.523	0.381		
	EBUF9	0.445	0.341		
	EBUF6	0.426	0.346		
Perceived Organizational E-readiness (POER)	POER6	0.775	0.568	0.727	KMOMSA=0.666 Bartlett's test= χ^2(15)=141.470 at p=0.000 Determinant=0.190
	POER5	0.738	0.374		
	POER1	0.691	0.303		
	POER2	0.687	0.559		
	POER3	0.522	0.230		
	POER4	0.468	0.211		
Perceived environmental e-readiness (PEER)	PEER7	0.804	0.586	0.742	KMOMSA=0.675 Bartlett's test= χ^2(15)=152.279 at p=0.000 Determinant=0.167
	PEER6	0.741	0.529		
	PEER5	0.701	0.373		
	PEER1	0.686	0.360		
	PEER3	0.568	0.332		
	PEER2	0.434	0.201		

Table 3 shows the descriptive statistics of the six research variables and the correlation between them. It is evident that all constructs hold discriminant validity (r<0.800).

Table 3. Correlation matrix and Descriptive Statistics

	Mean	SD	ECAP	SIZE	ITSP	EUSE	POER	PEER
ECAP	3.96	1.758	1					
SIZE	11.72	34.109	0.045	1				
ITSP	75615.46	160053.075	0.120	0.760	1			
EUSE	0.00	1.000	0.507	0.103	0.328	1		
POER	0.00	1.000	0.439	-0.092	0.032	0.398	1	
PEER	0.00	1.000	0.203	0.087	0.218	0.354	0.324	1

EMPIRICAL ANALYSIS

The proposed model in Figure 1 was tested using path analysis in Amos 17. This technique was chosen over multiple regressions because it can account for measurement error, tests all hypotheses in the model simultaneously and controls Type I error. The empirical analysis involved a number of assessment steps.

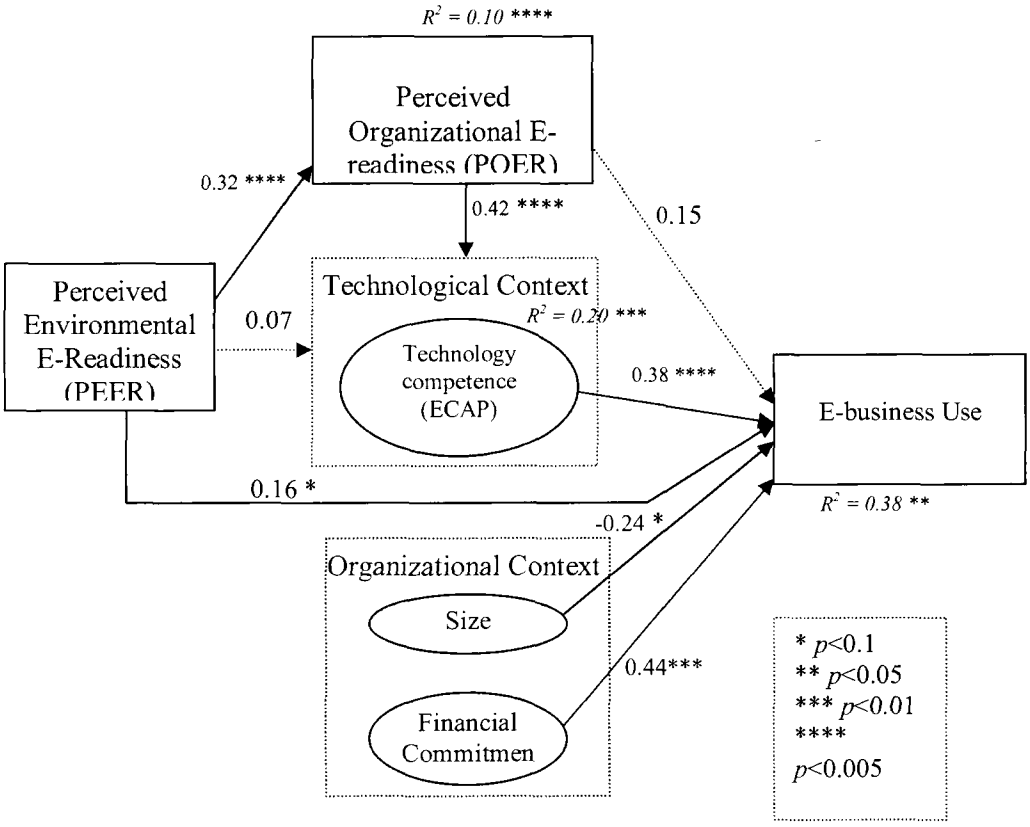

Figure 2. Full Model Test Results

First, the model was evaluated whether it fits the data using Bollen–Stein bootstrap χ^2. The result shows that the model represents the data very well: $\chi^2(6)=7.737$ at $p=0.798$, IFI=0.982, TLI=0.953, CFI=0.981, RMSEA 0.072 at $p=0.308$, SRMR=0.066. Second, the hypotheses were examined by estimating standardized path coefficients. The result (see Figure 2) shows that out of the eight hypotheses, six are supported. The relationship between *financial commitment, perceived environmental e-readiness (PEER), technology competence and e-business use* is positive, whereas *size* has a negative relationship with e-business use. The paths linking perceived organizational

e-readiness (POER) with e-business use and perceived environmental e-readiness (PEER) with technology competence are positive albeit statistically insignificant. It appears that the relationship between POER and e-business use is indirect and mediated through technology competence (b=0.16 at p=0.001). Likewise POER mediates the relationship between PEER and technology competence (b=0.13 at p=0.004). Therefore, all the hypotheses (excepting H1 and H4) are supported.

Third, the extent the proposed model can predict e-business use was assessed using square multiple correlations. The result shows that the model explains 38% of the variance in e-business use. The model also shows that PEER explains 10% of the variance in POER. Further, 20% of the variance of technology competence can be explained by e-readiness (both organizational and environmental) factors.

DISCUSSION

This study set out to examine sector-based e-business use taking the case of the Australian horticulture sector. The empirical analysis shows five major findings that contribute to both global IT management and e-business research and e-business in horticulture practice.

First, from the e-business use descriptive results, it is evident that the extent of e-business use in the Australian horticulture supply chain is at an early stage of maturity.

Two of the top five business functions performed electronically relate to providing information via a Website. There is limited use of e-business to sense, monitor, track and transact horticulture activities. Thus, supply chain collaboration capabilities of the horticulture sector have yet to be e-enabled. Very few organizations e-enabled their supply chain execution activities with only 22% and 29% exchanging real-time pre and post transaction trading information online respectively. Use of e-markets for selling and/or buying is limited. This result shows that in view of the increasingly complex demands of global supermarkets on horticulture firms and the widely acknowledged potential of e-business based supply chains to respond to those demands (Hewett, 2006), the horticulture sector has yet to assimilate e-business practices in the supply chain. This finding adds to the cumulative knowledge of the diffusion of e-business use in different sectors of the global economy.

Second, within the integrated model, technology competence, financial commitment, perceived environmental e-readiness and size have a positive and significant effect on the e-business use of horticulture firms. Amongst these factors, financial commitment and technology competence have the strongest effect. The structural inertia that large firms face in e-business use vis-à-vis the slack resources that such firms can commit to e-business use is reflected in the negative linkage between size and e-business use

and the strong covariance between size and financial commitment respectively. Perceived environmental e-readiness in the form of normative influence from horticulture associations, pressure from customers, suppliers and competitors; government incentives and the availability of support from the IT industry play a significant role in influencing e-business use.

Third, the linkage between perceived organizational e-readiness (POER) to e-business use is positive. However, it becomes significant when mediated through technology competence. A higher degree of POER is associated more with acquiring initial technology competence and less with using e-business. On the other hand, perceived environmental e-readiness (PEER) is associated more with continued e-business use and less with initial technology competence building. These results are consistent with PERM's postulation that organizational e-readiness are more powerful in affecting entry level e-commerce adoption whereas PEER forces together with commitment have significant effects on the institutionalization of e-commerce adoption (Molla and Licker, 2005b:102). Thus, Swanson's (1994) suggestion that the factors that facilitate innovation in its early phase could be the opposite of those facilitating later phases appears to hold true in the context of horticulture and e-business.

Fourth, the POER and PEER factors explain 20% of the variance for technology competence. Previous studies that used PERM (Molla and Licker 2005b; Lai et al, 2006; Tan et al, 2007) have not tested the possible relationship that might exist between the POER and PEER factors. Our integrated model allowed us to theorize and test this relationship. The R^2 value related to POER and the significant PEER to POER path loading indicates a possible structural relationship between PEER and POER factors worth exploring in future studies.

Fifth, and in terms of practice, the Australian horticulture supply chain appears to lack e-readiness and technology competence. This seems to suggest that the agribusiness sector exhibits limited e-maturity and might require special attention to be integrated into Australia's digital economy. This also explains why previous research has found a slower pace of technology adoption in rural industries (Access Economics 2005) and a less than 20% adoption of broadband Internet in the agricultural value chain (Wondu Business, 2004). Furthermore, findings from this study indicate that horticulture industry associations, government and the IT industry can play a role in disseminating e-business knowledge, in providing incentives and in showcasing relevant applications respectively. These are very important to create a chain effect in building the organizational e-readiness that leads to investing in technology competence, and ultimately, e-business use.

IMPLICATIONS FOR GLOBAL IT RESEAERCH

The paper has several implications for understanding the global diffusion of e-business and the challenges of e-business management. It identifies the e-business strengths and weaknesses of a critical global economic sector that has received little e-business research attention. The result shows that the integrated model explains 38% of the variance in e-business use. For comparison, whilst Zhu and Kraemer's (2005) OTE based model explained 36%, Molla and Licker's (2005b) PERM model explained 26%. Thus global IT researchers can use the integrated model in future studies.

While the findings of this study are consistent with previous studies (Zhu and Kraeamer, 2005; Molla et al 2005b; Travica et al, 2007; Xu et al, 2009), they also show some unique relationships that were not tested previously. Some global IT researchers (Lertwongsatien & Wongpinunwatana, 2003; Xu et al, 2009) consider financial resources and technology as measures of organizational readiness. The integrated model has differentiated the objective measures of the technology and the organizational context (such as having a particular technology or not and dollars spent on IT) from judgmental and dynamic measures of e-readiness. As a result, it was possible to investigate the net effects of organizational e-readiness on e-business use as distinct from a firm's financial outlay and the technology infrastructure. Among all the antecedent variables, the most significant factors are the financial commitment followed by technology competence. This finding reflects the unique characteristics of agribusinesses in general and the horticulture sector in particular, which tended to invest less on supply chain coordination and execution (Pollard 2003, O'Keeffe and Mavondo, 2005). Thus, the proposed integrated model appears to have sufficient explanatory potential to reflect the unique characteristics of the horticulture sector and represents an original contribution for the sector-based study of IT and e-business use globally.

In terms of the empirical results, not all of the results found here might be applicable to all countries and regions of the world. It is anticipated that if this study were conducted in a country such as New Zealand, that shares a similar geographic location but is significantly smaller than Australia, findings would be similar. This is because of the remote location and the costs involved in setting up an appropriate infrastructure to harness the full benefits of e-business. Furthermore, given the large proportion of micro and small organizations in the sample, it is not surprising that e-business is not heavily experimented with and adopted. Such firms often lack both the motivation and resources to invest in innovations that can increase the visibility of the supply chain. Other geographically limited regions and micro and small organizations would experience similar findings

If this study were replicated in European and North American countries, the findings might be different. This is because there is greater access to business-to-business technologies, such as bar-coding, RFID and electronic data interchange along the agribusiness supply chain (Graham, 1998, EC 2008). These technologies are more prolific than the basic informational use of e-business within Australia. In other words, there is greater capability for sensing, monitoring, tracking and general supply chain coordination and collaboration. Furthermore, given the size of the agribusiness industry in those regions, there is a greater degree of e-readiness and maturity.

LIMITATIONS AND FUTURE RESEARCH

The study has some limitations. In terms of its sample size, a larger sample size is desirable for greater stability of the findings and external validity. Future research using a larger sample size is therefore needed to test if the results obtained here are replicable. This study has considered the horticulture sub-sector of Australia as one important example of the agribusiness industry. These limitations imply that the generalization of the findings documented here to other agribusiness industries in general and all horticulture firms in particular should be cautioned and requires further research. Nevertheless, both the single country and horticulture focus do not lead us to suspect that the integrated model might not be applicable in other industries and countries. Future studies covering other sub-sectors of agribusiness and several countries would shed light over interesting questions such as: do the patterns identified in horticulture prevail in other sectors? What other relationships exist and how are they different from the patterns that emerged in this study? The model described in this study constitutes a contribution to guide such further studies.

CONCLUSION

Agribusiness, by its nature, is one of the most business-to-business oriented industries. Traditionally, agribusiness has been one of the early adopters of electronic trading, the adoption of Internet-based e-business and agribusiness's participation in e-markets remains less researched. This study set out to address four basic questions. Drawing from the Perceived E-readiness Model (PERM) and Organization Technology Environment (OTE) framework, an integrated model of e-business use is proposed and empirically tested. The results of this study show that e-business use within the horticulture sector is at the initial state of maturity.

In terms of the antecedent factors, this research shows that technology competence, financial commitment, perceived environmental e-readiness (PEER) and size are influential factors that directly affect e-business use. Perceived organizational e-readiness (POER) has an indirect influence on e-business use. In summary, the main contributions of the paper include (1) combining the OTE and PERM models into an integrated framework; (2) demonstrating the utility of the integrated framework to

study sector specific e-business use; (3) defining e-business use in the agribusiness construct and identifying and validating items to instrument it; (4) testing the relationship between the PEER and POER construct of PERM; (5) contributing to the knowledge of e-business use and its antecedents in a globally important economic sector that has thus far received very little research attention; and (6) adding to sector specific e-business knowledge.

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APPENDIX 1: Instrument used to collect data

Initial Item Measures for E-business Use

Five point scale anchored by 1= Not at all --- 5=Great extent

Code	Item	Reference
EBUF1	Information on growing, climatic conditions and harvest maturity are exchanged with trading partners electronically in ***real-time***	Barua et al (2004); Zhu and Kraemer (2005); Access Economics (2005); Bryceson (2003); Bryceson (2006)' Pollard (2003) Hewett (2006) Montealegre et al (2004); Volpentesta and Ammirato (2007)
EBUF2	Stock availability, prices or delivery times are shared with trading partners electronically in ***real-time***	
EBUF3	Exchange trading information (orders, delivery notices, invoices, statements, remittance advice) online and in ***real-time***	
EBUF4	Electronically monitor growth conditions of products on-farm and report the information back in ***real time***	
EBUF5	Electronically monitor environmental conditions of containers in transit and report the information back *in* ***real time***	
EBUF6	Shipment and logistics management are facilitated with suppliers and distributors via the Internet	
EBUF7	Use or provide on-line order/shipment tracking and tracing	
EBUF8	On-line collaboration to schedule spraying and harvest programs	
EBUF9	Remote displaying/viewing of products during production	
EBUF10	Joining electronic intermediaries (e-markets) for on-line purchase or sale	
EBUF11	Website supports online communities (e.g. discussion forums)	
EBUF12	Website provides access to databases relevant to horticulture industry	
EBUF13	Website provides information relevant to horticulture industry	

Initial Item Measures for Perceived Organizational E-readiness (POER)

Five point scale anchored by 1= Strongly Disagree---5=Strongly Agree

Code	Item	Reference
POER1	Our business has adequate awareness about the relevance of e-business to our practice	Molla and Licker (2005a,b); Lai et al (2006); Tan et al (2007)
POER2	We believe that e-business can provide benefits to our line of business	
POER3	We have adequate resources to access and use the Internet	
POER4	Our business processes that can be automated have already been automated	

POER5	We have adequate managerial and technical capability for e-business implementations	
POER6	We are willing to provide the necessary resources for implementing e-business practices	

Initial Item Measures for Perceived Environmental E-readiness (PEER)

Five point scale anchored by 1= Strongly Disagree---5=Strongly Agree

Code	Item	Reference
PEER1	E-business solutions and technologies relevant to the horticulture industry are widely available in Australia	Molla and Licker (2005a,b); Lai et al (2006); Tan et al 2007)
PEER2	Australian government provides incentives for e-business	
PEER3	Industry association play active role in promoting the use of e-business	
PEER4	Government requires that we engage with them electronically	
PEER5	The nature of competition in horticulture encourages the use of e-business	
PEER6	Our customers are ready to engage in e-business	
PEER7	Our suppliers/partners are ready to engage in e-business	

Measures of Organizational Context

Code	Item	Indicators	Reference
SIZE	Size	No of employees	Zhu and Kraemer (2005)
ITSP	Financial commitment	IT spending as percent of total revenue	

Measures of Technological Context

Code	Item	Indicators	Reference
ECAP	IT competence	Number of items the establishment has in the following list: 1. On-farm electronic monitoring 2. Computerized Farm Accounting 3. Broadband Internet connection 4. Website 5. Internet enabled tracking systems 6. Internet enabled cold chain systems 7. EDI (Electronic Document Interchange) 8. GPS (Global Positioning System) 9. Barcoding 10. Mobile and wireless technologies	Bryceson(2006); Zhu and Kraemer (2005) ; Stricker et al (2003)