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E-business Diffusion among Australian Horticulture Firms

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Abstract

The aim of this paper is to understand the extent of e-business utilisation in the horticulture supply chain, an area where there is little research coverage. To achieve this, we assess the current and planned adoption of e-business technologies and functions. Data were collected through a survey of Australian horticulture growers, service providers and industry associations. The findings indicate that, while farm management systems (such as computerised accounting) and mobile technologies are widely diffused, the uptake of e-supply chain technologies is limited. Correspondingly, existing e-business functions are by and large informational and there is a general lack of sense, monitor, track and supply chain coordination and collaboration e-business capabilities. The future doesn't look promising as most of the respondents have neither a plan nor an intention for upgrading the implementation of e-business. Some of the reasons appear to be lack of pressure from market forces and the fact that respondents are yet to be convinced about the value of e-business to generate efficiency and return on investment. The results have established a benchmark that provides an understanding of developments in e-business in agribusiness. Some implications of the results are discussed.

Keywords: E-business, Diffusion, Adoption, Assimilation, Agribusiness, Horticulture Supply Chain Australia.

1. Introduction

Despite the widely acclaimed potential of e-business to transform business and supply chains, its diffusion in different sectors of an economy greatly varies. The agribusiness industry is one of the early users of electronic trading (Bryceson, 2006). Long before the Internet, there were successful electronic trading mechanisms for auctioning flowers (Van Heck, and Ribbers, 1997), for citrus fruits (Hendersen, 2001) and for exchanging other agricultural products such as eggs and cotton (Montealegre et al, 2004). The homogeneity of agricultural products, the volume of fragmentation along the supply chain and the need for immediate transfer of goods accompanying documents for quality assurance, inspection and trading makes Internet based e-business an attractive, perhaps an expensive, proposition for most agribusinesses (Williams, 2001; Muller 2001).

Various Australian State and Federal governments have been keen to promote greater use of e-business models, processes and technologies along the agribusiness supply chain and many regional and national organisations and associations have implemented policies and systems to support such use (Knox, 2005; Ng, 2005). Some examples include:

- Ex-Doc, a federal government e-business initiative that allows horticultural exporters to electronically file health and/or phytosanitary documentations with the Australian Quarantine Inspection Service (AQIS) in order to get an export certification;
- Excel-erate, an e-business system developed by the Australian Banana Growers' Council that provides growers with a framework to benchmark their business activities and performance against peers and targets;
- ChemCheck, an online and independent service to assist horticultural and other growers to make safe and correct use of chemicals;
- Tradegate ECA, 1-Stop allows exporters to lodge export information electronically and book for export related activities (such as packing, trucking, shipping, container entry) (AccessEconomics, 2005); &
- Most of the grower associations provide on-line informational services related to growing time, temperature guide, handling guide and care chart. For instance, Australian Horticulture Exporters Association (AHEA) hosts a list of exporters and other logistics providers and plays an infomediary role for trade opportunities through its member update services. Australian Almonds Association provides limited and selected seller aggregation services that facilitate buyers to easily locate Almond sellers. Almond Board of Australia aggregates a list of service providers ranging from banking and finance through harvesting to hulling and shelling to processing and marketing. It is not however clear to what extent growers actually make use of this information

A few previous studies have therefore researched e-business in agribusiness. Mueller (2001) applied economic theory to understand the existence and nature of entrepreneurship in agricultural e-commerce. A number of other researchers have investigated the rise and fall of agricultural e-markets and the critical factors that contribute to their success (Clasen and Mueller, 2006; Henderson, 2001; Montealegre et al, 2004; Willams, 2001). Some argue that agribusiness is "an inefficient industry which could benefit greatly from the application of e-commerce practices" (Clasen and Muller, 2006: 350). Drawing from a case study, others outline how internet-enabled business practices improve efficiency and productivity in the peanut industry (Bryceson, 2003). Case studies of Australian Grain farmers' use of precision technologies indicate that, those farmers are able to recover their investment within three years (Tickner, 2008). Still others consider "e-commerce coupled with geographical typicity of agrifood products as important leverages for the economic development of a lagging rural region where agribusiness is a leading sector of its economy" (Volpentesta, & Ammirato, 2007). Trevarthen (2007) analyses how recent 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 not only to comply with NLIS requirements but also because of farm management benefits. Some work has also gone into exploring the types of B2B e-business models that agribusiness firms use (Ng, 2005). A few scholars investigated the adoption of basic e-business technologies such as the Internet and the Web (Martin and Sellitto 2004; Stricker et al, 2003; Wondu Business, 2004).

Synthesis of the published literature, demonstrate a number of issues. First, although there is a general optimism about the benefits of e-business in agribusiness and anecdotal case evidence, the paucity of lack of empirical evidence to support such claims raises the question if such expectations are indeed realistic. Second, during the "irrational exuberance" period of e-business, a number of dot-com companies had established e-markets catering for the needs of agribusinesses. Most of these businesses were the first fatalities of the dot-com bust because of failure to attract a critical mass of agribusiness. Some of the business models were not reflective of the realities of agribusiness trading and technological sophistication (Stricker et al, 2003). Third, we do not necessarily know if Federal and State government ICT-related initiatives (for example, those that mandate the use of RFID tags in certain agribusiness chains) to drive the efficiency and competitiveness of the agribusiness sector are producing desired results. Fourth, if e-business can indeed benefit agribusiness, then one would expect it to be widely diffused and assimilated among agribusinesses as a preferred set of practices. However, beyond basic Internet and Web technologies, there is not much research about the extent of e-business assimilation in agribusiness. As such, beyond the Internet and the Web, we do not know the extent of utilisation of other e-business and e-business enabling technologies and the business functions they support. In particular, none of the previous studies dealt with e-business in the horticulture sector.

The aim of this paper is therefore to address some of the above gaps through an investigation of e-business diffusion along the Australian horticulture supply chain. Specific questions addressed are:

- What is the current status (and future plan) of e-business technologies adoption among Australian Horticulture firms?
- To what extent are horticulture firms' business processes and functions e-enabled currently and what are the plans to do so in the future?
- In what ways is e-business benefiting agribusinesses and what are its main drivers?

In addressing the above questions, the paper does not take a position either to advocate for or otherwise of e-business in agribusiness. Instead, drawing from existing literature on e-business in general and those that deal with e-business in agribusiness in particular, it attempts to provide empirical evidence as regards the diffusion of e-business in the horticulture supply chain. In view of the call for sector specific e-business studies, the paper makes unique contributions to the agribusiness research by offering knowledge as to the diffusion of e-business in traditional industries. Furthermore, this paper helps to highlight the prospect of agribusiness supply chains to integrate to the emerging digital economy. In Australia in particular, the application of digital technologies to enhance the competitiveness of agriculture is a key national research priority. This paper provides useful knowledge to understand and benchmark the state of e-business among Australian horticulture.

The rest of the paper is organised as follows. The next section provides a background of the horticulture sector in Australia, which is followed by a discussion on e-business. After highlighting the research methods, the findings of the study will be presented and analysed. The paper concludes with some observations that emerge from the findings.

2. Industry Background

The Australian horticulture sector is composed of fruits, vegetables, nuts, nursery, extractive crops, cut flowers and turf. Economically, it is a $7 billion industry with an export value of more than 800 million, represents about 18,000 enterprises, and employs over 80,000 people (ABS, 2008; HAL, 2008). Horticultural establishments comprise approximately 16% of all Australian agricultural enterprises, contribute 20% of agricultural employment and are the fastest growing industry in agriculture (HAL, 2008).

Socially, horticulture enterprises shape the livelihoods of rural Australia and affect the ability of close rural communities to respond to environmental challenges. In addition to growers, the horticulture supply chain includes production, harvesting, post-harvest, logistics and marketing service providers and industry associations.

The Australian horticulture sector, like the rest of agribusiness, has a long tradition of export focus. However, it is also characterised 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). This, coalescing with the recurrent and often persistent drought, affects the visibility and global competitiveness of the sector (Graeme Forsythe, 2004 Wilkinson, 2005). The issue of drought, its impact on the industry structure and how the sector can cope with it, although very relevant, is outside the scope of this paper. Rather, this paper focuses on e-business related and e-business relevant issues.

From an e-business practices point of view, the change in the structure of competition from firm-based to supply chain-based competition requires effective integration of supply chains and supporting technologies. The new trend for more customisation of agricultural products and their trackability and traceability in the farm-to-retail chain necessitate effective sharing of information among the members of the horticulture supply chain (Trevarthen, 2007; Salin, 1998). Increasingly, horticulture customers are demanding detailed and up-to-date information about the environmental and social characteristics of products (Matanda and Schroder, 2002). The industry is in dire need of efficient compliance, transaction fulfilment and logistics systems that can reduce the total cost of the supply chain (O'Keeffe and Mavondo, 2005). Among different factors that can potentially help the industry to become globally competitive, adopting new technologies and innovative practices plays a key role (HAL, 2006). E-business offers agribusiness opportunities to address some of these challenges (Bryceson, 2006). However, the realisation of e-business opportunities depends on the balance of costs and benefits of investing in e-business technologies. The following section reviews background concepts of e-business in order to lay the conceptual foundation for the survey.

3. E-business background

For the purpose of this paper, we define e-business as the use of the Internet and other information and communication technologies (ICTs) to conduct business transactions. Thus defined, e-business can contain two main areas: e-business technologies and e-business functions (Swaminathan and Tayur, 2003).

For those that can afford it, a number of e-business and e-enabling technologies that are relevant in the horticulture supply chain exist. The general trend also indicates an increase in the use of basic information technology such as computer and the internet among farmers (Tickner, 2008, Trevarthen, 2007; ABS 2005). It is possible to classify these technologies into four categories as farm automation, Internet, e-supply chain and mobile and wireless technologies. Farm automation technologies can allow real-time monitoring of the growth and climatic conditions of agricultural products (Ton et al, 2001). Such systems can be applied in pre-harvest maturity monitoring, ripeness determination and post-harvest treatment (Baerdemaeker, 2001). Tickner (2008) reports that the use of farm automation technologies in the grain farm industry produced both tangible and intangible results. Tangible benefits include 10% cost savings from reducing spraying overlap and overall benefit of $14 to $30 per hectare. Intangible benefits include the "ability to conduct on farm trials, increased knowledge of the variability in paddocks, and increased confidence in varying fertilisers" (Tickner, 2008: 1).

The integration of farm automation technologies with real-time customer and market information systems can provide opportunities to adjust production quantity and quality based on customer requirements. Internet technologies such as broadband and Websites enable firms to communicate, interact, and transact with their suppliers, customers and other partners. E-supply chain technologies include internet-enabled tracking and cold-chain systems, electronic document interchange, bar-coding and global positioning systems. The adoption of these technologies in the supply chain facilitates accurate ordering, delivery and invoicing, which are integral to an industry's profitability. These technologies also facilitate better communication, collaboration and co-ordination across the supply chain. The advent of mobile technologies and short messaging service (SMS) has also become an increasingly important tool for sharing market and other horticulture specific critical information. These technologies are instrumental in co-ordinating the activities of the members of the agribusiness supply chain (Molla and Peszynski, 2007). The above leads to following question:

Research Question 1: What is the current status of e-business technologies adoption among Australian Horticulture firms?

E-business functions refer to the deployment of the e-business technologies to support specific business processes and activities. Because of the increased convergence of technologies, one technology can perform a number of functions. By focusing on the e-enabled business functions, it is possible to understand the assimilation of e-business in horticulture. Distinct from e-business adoption, e-business assimilation refers to the development of e-business capabilities indicating the breadth and depth of e-business use in both consumer- and business-oriented activities (Raymond et al, 2005). Customer-oriented activities include those that are designed to provide customers with information, products and services. Customer-oriented e-business activities can allow firms to overcome some of the geographical barriers of trading globally and to access markets that would have otherwise been impossible to them. In addition, such activities can enable firms to by-pass some of the traditional market intermediaries and save on market transaction costs (Molla and Heeks, 2007).

Business-oriented activities consist of electronic interactions among enterprises. Such technologies facilitate inter-business communication, co-ordination and collaboration. The Internet opens new venues for horticulturalists to create flexible supply chains by offering high-speed communication and tight connectivity. These technologies enable supply chain members to remotely monitor growth conditions of products on farm and environmental conditions of containers in transit. They also facilitate tracking and tracing shipments. This helps members of the chain to address problems of information access, information asymmetry and uncertainty (Barua et al, 2004). Better information flow in the supply chain facilitates effective co-ordination and collaboration with other members of the chain, often referred to as collaborative planning, forecasting and replenishment (CPFR) (Premkumar, 2000). Through effective supply chain collaboration and administration, firms can improve their planning and execution, reduce cost, minimise overall risk and improve customer satisfaction (Premkumar, 2000; Swaminathan and Tayur, 2003). Based on the above discussion, we can identify three categories of e-business functions: supply chain information; sense, monitor and track supply chain execution; and supply chain co-ordination and collaboration. The above leads to the following question.

Research Question 2: To what extent are horticulture firms' business processes and functions e-enabled?

While e-business has been available for some time, and there is general optimism about its benefits, excepting a few case studies (see Tickner, 2008; Trevarthen, 2007 and Bryceson, 2003) there is a lack of evidence as to either its real or perceived benefits and to what extent that influences agribusinesses' decision to invest in e-business. Thus,

Research Question 3: In what ways is e-business benefiting agribusinesses and what are its main drivers?

4. Research Method

The research reported in this paper is part of a project that investigated the impact of e-business on the performance of horticulture firms. Data was collected through a cross sectional survey of firms in the horticulture supply chain between September and October 2007. To select survey participants, we developed a sample frame from a combination of a database leased from a commercial database provider, Web searches and from members of the Australian administrator of global supply chain standards. The sample frame included horticulture growers, horticulture associations, pre- and post-harvest service providers, horticulture marketing service providers, wholesalers and retailers. Further, a mix of micro, small, medium and large businesses were included in the sample.

Data collection took place using a self-administered questionnaire. A package including a postage paid return envelope, personally addressed to the General Manager (or equivalent) of each of the organisations was mailed out. There were a total of ten questions capturing the use of e-business technologies on a three point scale of "have now", "plan to have" and "will never have". Thirteen questions were asked to understand the extent of utilisation of e-business. The scale for the extent of use of e-business functions was a five point Likert type scale ranging from (1) not at all to (5) great extent. Further, respondents had the options of choosing "plan to use" and "not applicable".

To encourage response and minimise bias, the covering letter provided a plain language description of the project and assured respondents that their responses and identity remain confidential. After four weeks, we made over 450 follow up phone calls to randomly selected potential respondents. Of the 1335 mailed out questionnaires, 40 bounced back as undeliverable because of either business closure, or address change or name change. Of the delivered questionnaires, 101 replied giving an 8% response rate. Nine had too many missing data points and were excluded from the analysis. This resulted in 92 usable responses.

To estimate the presence and extent of non-respondent bias, following an established norm in the literature (Molla and Licker, 2005; Thong, 1999; Overton, 1977), we compared early respondents with late respondents, especially those that responded after reminders were sent out. This test, which is also referred to as extrapolation (Armstrong and Overton, 1977), is based on the assumption that late respondents are likely to have characteristics similar to those of non-respondents. There does not appear to be a literature that discusses how to select the characteristics that are to be used for comparing early and late respondents. It appears that such selections are at the discretion of individual researchers. We, therefore, compared the first 15 respondents with the last 15 respondents on the bias of the adoption of e-commerce technologies. The result (Table 1) indicates that there is some element of interest bias in the sample as early respondents appear to be adopters of e-business technologies compared to late respondents (and by extrapolation non-respondents). This implies that any generalisation from the sample to the population should be made cautiously.

Table 1: Non-response bias estimate

Item	Mean		t	p
	Early Respondents	Late Respondents		
On Farm Monitoring	1.9	2.3	-0.9	0.37
Computerized Accounting	1.1	1.5	-1.5	0.14
Broadband Internet	1.0	1.8	-2.9	0.01
Website	2.0	1.1	4.0	0.00
Internet enabled tracking systems	2.2	1.7	1.5	0.16
Internet enabled cold chain systems	2.1	2.3	-0.5	0.62
EDI	1.8	2.5	-2.3	0.03
GPS	1.9	1.7	0.7	0.47
Barcoding	1.5	2.3	-2.6	0.01
Mobile and wireless	1.3	1.2	0.7	0.49

5. Results

5.1 Respondent Profile

Most of the respondents (86%) who completed the questionnaire were general managers or their equivalent (such as managing directors, Chief Executive Officers, or owners) (see Table 2). The rest had different titles such as export director, administration manager, business development manager and president. The businesses have been operating on average for 28 years - the oldest being 128 and youngest three years. Fiftytwo percent of the firms grow fruits, vegetables, plants and cut flower, while 32% are involved in production, harvesting, post harvest and logistic and marketing services. While 36% of them are engaged in two lines of businesses such as growing and services, another 17%, 7% and 2% operated three, four and five lines of businesses respectively. This shows very limited vertical integration in the horticulture supply chain. Thirty-three percent are involved in export trading. According to the Australian Bureau of Statistics classification, and using full time equivalent employees as an indicator, 79% are micro and small businesses. The average business size is small. Table 2 presents summary information of the profile of respondents.

Table 2: Summary of firms in the sample

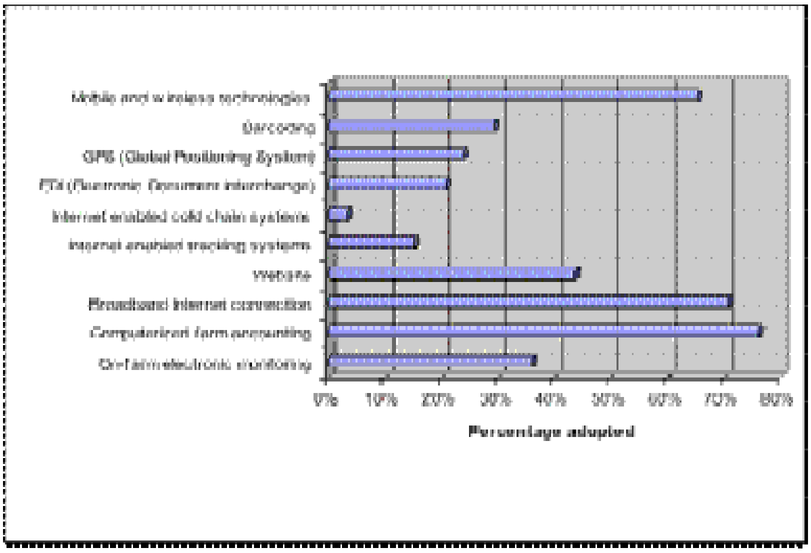
Business age	No. of respondents		Percentage	
<= 10	16		21%	
11---25	33		42%	
26-- 50	24		31%	
51--100	7		9%	
>101	2		3%	
Missing	10		13%	
Sector	No. of respondents		Percentage	
Fruit Growers	46		34%	
Vegetable growers	9		7%	
Plant nurseries	12		9%	
Cut flower and flower seeding	4		3%	
Production and harvesting service	16		12%	
Post-harvest and logistics services	12		9%	
Marketing services	16		12%	
Wholesale/retail	12		9%	
Horticulture associations	10		7%	
Business employee size	Full time Equivalent		Including casual	
Micro (<=4)	No.	%age	No.	%age
Small (5-19)	39	41%	14	14%
Medium (20-99)	34	33%	36	37%
Large (>=100)	3	5%	22	24%
Missing	1	1%	8	9%
	15	17%	12	15%

5.2 Status of E-business Technologies Diffusion

To assess e-business technology diffusion, the study investigated the implementation of ten different e-business technologies. Figure 1 describes the result and Table 2 summarises the sector-by-sector adoption of these technologies. Of the ten surveyed technologies, computerised farm accounting is the most widely diffused (76%). 92% of plant nurseries and only 22% of vegetable growers use this technology. Most (71%) have broadband Internet connection and the majority (63%) have adopted mobile and wireless technologies. Of the ten technologies, Internet-enabled cold chain systems, with only 3% adoption, demonstrates the weakest uptake. In view of the fact that the majority of the respondents are growers, this should not be very surprising as these systems are useful for logistics companies. Surprisingly though, none of the logistics companies in the sample adopted this technology. Further, only 15% of the respondents have implemented Internet enabled tracking systems. Similarly, only a small proportion of respondents had implemented bar-codes (29%), GPS (24%) and EDI (21%). GPS and GIS technologies form the core of precision agriculture and enable farmers to process essential farm data faster and easier than traditional paper and pencil technologies. Case studies of the implementation of precision agriculture in Australian Grain Farms indicate that an average spent of $14 to $44 per hectare yields an annual benefit of $14 to $ 30 per hectare (Tickner, 2008).

The limited use of e-business technologies gives a preliminary indication that the diffusion of e-supply chain technologies among Australian horticulture is at its infancy stage. It also indicates that horticulture e-business has yet to permeate established value chains. The limited diffusion of supply chain technologies might lead to missed opportunities in terms of better communication and co-operation across the supply chain; reduction in the amount of errors that occur in a standard transaction between trading partners and in minimising data-caused delays in business processes. It also might affect the ability of horticulture to reduce cost significantly and participate in the “sense and respond” strategy that major retailers are endeavouring to develop.

Figure 1: E-business technologies diffusion



Of all members of the horticulture supply chain surveyed, plant nurseries appear to show the most aggressive stance (see Table 3) with 100% adoption of five out of the ten technologies. To the contrary, vegetable growers tend to lag in most of the technologies adoption with the exception of computerised farm accounting and mobile technologies (Table 3). However, one should not take this at face value because of the unequal distribution of the respondents across the sectors. A close examination of the within-sector percentage distribution of the implemented technologies reveals that with the exception of plant nurseries, all sectors tend to be at a relatively similar stage. Again, this finding should be interpreted by making allowances for the number of respondents in each sector.

Table 3: Sector distribution of e-business technologies diffusion

	1	2	3	4	5	6	7	8	9	10
Fruit Growers	43%	63%	57%	26%	11%	2%	17%	20%	24%	57%
Vegetable growers	22%	89%	56%	33%	11%	0%	22%	33%	11%	78%
Plant Nurseries	92%	100%	100%	100%	100%	92%	92%	92%	92%	100%
Cut flower	75%	75%	50%	75%	25%	0%	0%	0%	25%	25%
Prod and harvest services	63%	81%	81%	50%	13%	0%	25%	25%	31%	81%
Post harvest services	58%	75%	50%	58%	8%	0%	25%	17%	42%	67%
Marketing services	56%	81%	69%	56%	19%	0%	19%	25%	31%	94%
Wholesale/retail	25%	83%	83%	50%	8%	0%	25%	25%	42%	83%
Association	30%	65%	80%	65%	30%	15%	30%	40%	35%	65%

For column heading refer to Figure 1, such that 1=On farm electronic monitoring;...4=website;..10=wireless

We anticipated that e-business technologies would be more diffused among recently established firms (less than 15 years). However, our ANOVA analysis indicated that there is no significant difference based on the age of the business. For example, bar-coding was adopted among 31% and 30% of recently established and older businesses respectively. Forty two percent of younger and 33% of older firms are using on-farm monitoring. Internet enabled tracking systems are used by 15% and 18% of young and old firms respectively. The level of implementation of the e-business technologies between micro and small (MSE) and medium and large enterprises (MLE) shows some variation, with larger businesses leading the implementation ahead of the smaller ones especially in the farm monitoring, broadband Internet and bar-code technologies. However, the trend of implementation of the components within each size category shows no major difference and the same trend is observed across business size. That is, mobile, farm automation and basic Internet technologies show the strongest uptake whereas e-supply chain technologies show the weakest. In addition, the level of implementation of the components within each category remains fairly the same. For example Websites are implemented by 40% of MSEs and 60% of MLEs; an equal 22% of MSEs and MLEs respectively implemented electronic document interchange. In interpreting this finding, readers should be reminded that we have used the full time equivalent of employees (using Australia’s Bureau of Statistics classification) to measure business size. It is likely that other countries and regions have a different classification. In addition, use of other metrics such as revenue turnover might not lead to the same classification.

Previous studies have indicated that firms with global operation are likely to adopt e-business either to save the cost of business transactions or in order to expand their export activities (Xu et al, 2004; Raymond et al 2005). Thirtythree percent of survey participants are involved in export activities. The diffusion of e-business technologies among these firms follows more or less the general pattern observed earlier, i.e, mobile and farm automation leading and e-supply chain technologies lagging (see Table 4). However, relatively speaking, it appears that e-business technologies are more widely diffused among the exporting firms than the total population.

Table 4: Diffusion of e-business technologies among exporting firms

	Export % (n=26)	Total
On-farm electronic monitoring	62	36%
Computerised farm accounting	100	76%
Broadband Internet connection	81	71%
Website	62	43%
Internet enabled tracking systems	12	15%
Internet enabled cold chain systems	4	3%
EDI (Electronic Document Interchange)	35	21%
GPS (Global Positioning System)	15	24%
Barcoding	42	29%
Mobile and wireless technologies	81	65%

5.3 Status of E-enabled Agribusiness Functions

The use of the above e-business and other Internet based e-business technologies for performing 13 agribusiness functions were assessed. Table 5 provides a summary of the findings. The result indicates that, e-business practice in the Australian horticulture supply chain is in its infancy.

Two of the top five business functions performed electronically relate to providing information over a Website with limited sense, monitor, track, transactional and supply chain collaboration capabilities. Very few organisations e-enabled their supply chain execution activities with only 22% and 29% exchanging pre-transaction and post transaction trading information online and in real time respectively. Use of e-markets for selling and/or buying is very limited. Although some of the functions might not be applicable for some of the firms in the sample (such as horticulture associations), overall, the sector has yet to invest, if at all it would, in building e-supply chain management capabilities

Table 5: The status of e-business assimilation in the horticulture sector

Category	Item	%Agree
Supply chain Information exchange	Information on growing, climatic conditions and harvest maturity are exchanged with trading partners electronically in real-time	18%
	Website provides access to database relevant to horticulture	26%
	Website provides information relevant to horticulture	33%
Sense, monitor track	Electronically monitor growth conditions of products on-farm and report the information back in real time	9%
	Electronically monitor environmental conditions of containers in transit and report the information back in real time	2%
	Use or provide on-line order/shipment tracking and tracing	11%
Supply chain execution	Stock availability, prices or delivery times are shared with trading partners electronically in real-time	22%
	Exchange trading information (orders, delivery notices, invoices, statements, remittance advice) online and in real-time	29%
	Joining e-markets for on-line purchase or sale	6%
Supply chain collaboration and co-ordination	Shipment and logistics management are facilitated with suppliers and distributors via the Internet	16%
	On-line collaboration to schedule spraying and harvest programs	9%
	Remote displaying/viewing of products during production	3%
	Website supports online communities	7%

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5.4 Future Intentions

In order to assess the future diffusion of e-business technologies, we asked those respondents that have not adopted the technologies to gauge the applicability of each of the technologies to their line of business and whether or not they are planning to adopt them. As Table 6 indicates, the respondents are not planning major growth in the implementation of most of the technologies. Indeed, in view of the current rate of diffusion, plans are stronger in farm automation and mobile technologies. In particular, a significant proportion of respondents indicated that they will never adopt most of the e-supply chain technologies. For example, out of the 54% who are not intending to adopt cold chain systems growers constitute about 72%. Growers also constitute 73% of the 46% who do not plan to implement EDI. A few (and most of these are micro businesses) believe that e-business technologies are not applicable to them.

Table 6: Planned implementation of e-business technologies

	Intention to adopt (%)	Will never adopt (%)	N/A (%)
On-farm electronic monitoring	16	36	12
Computerised farm accounting	11	7	7
Broadband Internet connection	11	9	9
Website	32	18	7
Internet enabled tracking systems	29	42	13
Internet enabled cold chain systems	25	54	17
EDI (Electronic Document Interchange)	22	46	12
GPS (Global Positioning System)	25	40	11
Barcoding	29	30	11
Mobile and wireless technologies	18	9	8

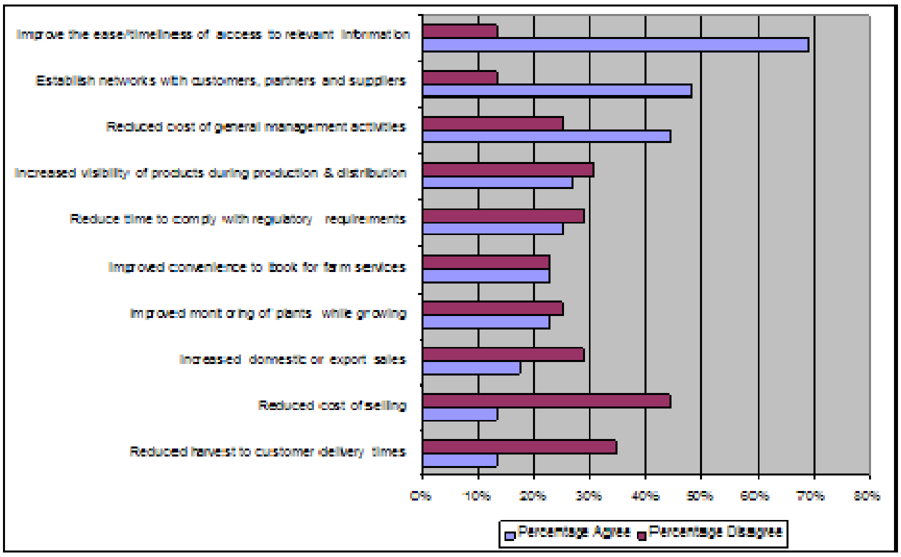
In terms of planned business functions to be performed using Internet-based networks, it can be considered to be insignificant. Only 10% indicated a plan to exchange trading information online and in real time. Nine percent intend to upgrade their Website to support online communities and 8% plan to exchange stock availability, price and delivery schedules.

5.5 E-business Benefits

The benefits firms experienced from their e-business investment and applications were assessed based on ten questions. Only about half of the respondents answered these questions. The findings (Figure 2) are consistent with the level of e-business technologies adoption and electronically performed e-business functions. Most of the respondents indicated that their e-business practices have allowed them to have easy and timely access to information relevant to their business. This corresponds with the most widely performed e-business function: the provision of, and access to, information via a Website.

Other benefits of e-business reported by more than half of the respondents comprise enhancing business networks with customers, partners and suppliers. Some respondents have experienced cost reductions related to general management activities such as planning, accounting and compliance processing. However, transaction cost savings such as shipping, scheduling, order processing, transporting and warehousing are very rare. Respondents that have experienced better e-business benefits are mostly growers of medium size. They tend to implement farm accounting, broadband, website, GPS and mobile and wireless technologies; have developed e-business capabilities related to exchanging growing, trading and shipment information online and in real time with partners; and demonstrated relatively better organisational e-readiness in terms of e-business awareness and commitment and its utility for staying competitive in the industry.

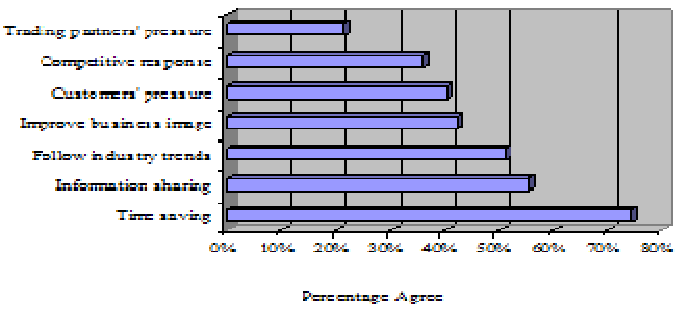
Figure 2: Distribution of e-business benefits



5.6 Drivers of E-business

The drivers of e-business can be grouped into three broad categories of efficiency (such as the need for more and better information sharing and time saving), legitimacy, (fear of being left behind because of not adopting e-business technologies and positive images associated with e-business adoption), and market forces (pressure from customers and trading partners to adopt e-business technology). Respondents were asked to express their degree of agreement regarding the main reasons that drive their organistion's e-business implementiono and use (Figure 3).

Figure 3: Drivers of e-business



Of the three e-business driver categories, efficiency drivers appear to be dominant followed by legitimacy. Market forces appear to play a limited role in driving e-business in horticulture. The limited adoption of e-business technologies and functions can therefore be due to the fact that respondents are yet to be convinced about the potential of e-business to generate efficiency and a positive return on investment.

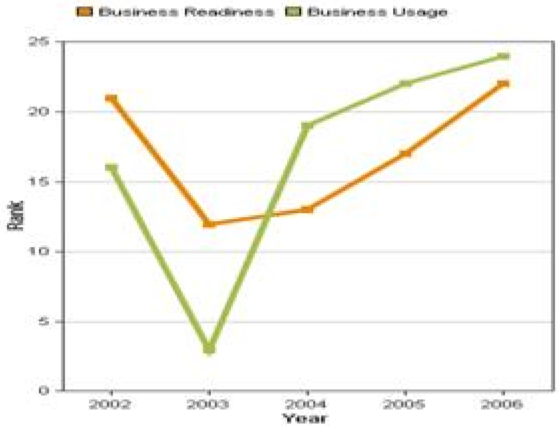
6. Summary and Conclusion

This study captures the implementation of e-business technologies and electronically performed business functions and provides a benchmark for future positioning and comparison. The findings, in terms of implemented technologies and e-business functions, reveal a consistent picture of the assimilation of e-business in Australian horticulture. At the time of the survey, farm management, mobile and Internet technologies are the most widely implemented technologies. In a similar fashion, most of the respondents reported using these Internet-based channels to enhance and support their information exchange, but the extent of use is limited and has yet to permeate the supply chain. Implementation plans for both e-business technologies and functions do not show great promise and appear to revolve around extending existing websites, broadband Internet and mobile technologies to enhance the exchange of information. Planned implementations of e-supply chain technologies and supply chain execution and collaboration and co-ordination capabilities tend to be very limited. The study has also established that, with existing implementation levels and further planned activities, the overall picture of e-business diffusion in the Australian horticulture supply chain is far from emerging as a preferred set of practices.

Respondents to the survey represent a wide range of sectors, size, and export orientation. However, the majority of them were upstream members of the supply chain. Attempts were made to highlight the sector, size, export-orientation-wise distribution of implemented technologies and business functions. Although some minor differences have been observed, none are statistically significant. Given the large proportion of growers and micro and small organisations in the sample, it might not be surprising that e-business is not heavily experimented with and adopted. Most growers are small companies run by a family that hires help during peak seasons. The family would be on the farm daily for the majority of the day and would not have the time to explore or implement technology within their company. These growers seldom have the time to attend industry-relevant roadshows and demonstrations according to key informants. Such firms often lack both the motivation and resources to invest in innovations that can increase the visibility of the supply chain.

This findings are a reflection of Australian businesses' e-business usage ranking which stands at 24, below India (20) and far below United Kingdom (9) (Mia and Dutta, 2007). In fact, since 2002, Australia's e-business usage has fallen from third in 2003 to 24th in 2006/7 (see Figure 4). They also could be a reflection of the lack of demonstrated and tangible e-business benefits in agribusiness. The assessment of e-business benefits indicates that, although corresponding to existing levels of e-business use, most firms have only experienced informational gains. For those that have invested in higher levels e-business capabilities, e-business might indeed improve market access, reduce the cost of transaction and coordination, and enhance the transparency and visibility of the horticulture supply chain. This corresponds with some of the anecdotal evidence of e-business for agribusiness (Tickner, 2008; Trevarthen, 2007; Bryceson, 2003). Nevertheless reasons for non-adoption need further investigation.

Figure 4: Australia's e-business readiness and usage index (Mia and Dutta, 2007)



This study has some value to future researchers of e-business. For example, some argue that there is a positive correlation between e-business maturity and e-business value. The findings discussed in this paper in terms of the status of e-business maturity can then be used to inform future studies interested in investigating such issues. The finding can be used as a be

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