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Internet and ITC Use among Agricultural SMEs: Evidence from Hawaii

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Abstract

Much of the SME research examining adoption and use of Internet and information and communication technologies (ICT) to date has argued that firms adopt and use the Internet and related ICTs to different extents depending on firm size, industry type and CEO education. To understand these issues studies tend to compare firms across industry sectors. The results though are mixed. Moreover, only a small percentage of SME ICT studies target agricultural firms. The study presented here surveyed SME farm operators in a narrow set of grower/producer sectors. Results indicate wide use of computers and the Internet, especially for functions like email, online purchasing, and online business-related research. Website ownership is less widespread. The study also surveyed the firms about their use of emerging social technologies like instant messaging, chat, blogs, etc. Perceptions of ICT benefits and reasons for not investing in them are discussed. Implications for future research and farm operators are also discussed.

1. Introduction

Prior research suggests that drivers of computer technology adoption in small businesses include lack of financial resources [9], lack of personnel with technical expertise [11], and the CEOs lack of experience with various information and communication technologies - ICTs [19]. A theme of these studies describes 'resource poverty' to be a common impediment to IT adoption. Small firms typically have fewer resources available than larger ones and are therefore less able to invest in computer technologies than large firms. Although resource restrictions certainly play a role in IT acquisition, the *need* to acquire new systems must also play a role. As firms grow they become more complex to manage. Greater organizational complexity requires more complex information capture and access strategies, entailing greater reliance on the structure and support provided by information systems. Thus, small firms become more motivated to obtain information technologies as they experience the need for more efficient and sophisticated information management. A logical conclusion seems to be that as a small business grows, it will experience a corresponding need for increasing adoption of all forms of IT.

It is also reasonable to presume that the industry sector a small business competes in can affect their systems requirements. For instance information intensity refers to the degree to which information is present in a business' primary product or service. Although no significant relationship was found between information intensity and likelihood of computer adoption, it was significantly related to extent of adoption [24]. Other studies have found differences in application complexity as a function of industry [12]. In other words, the characteristics of the industry sector a firm competes in likely affect the company's technology use, hence we expect that SME agribusinesses producing different crops will exhibit different ITC adoption and use patterns.

CEO education has been considered as a factor in ICT adoption by SMEs. For instance, although level of end-user education is significantly related to ICT satisfaction, no significant relationship between education level and use was found [9]. In that study however, end-users were workers in the general company population. In the current study, CEOs/operators in smaller businesses are seen as taking the role of end-users. More educated operators are more likely to have been exposed to computers during advanced education courses and are thus more likely to support ICT adoption.

ICT Use in SME Agribusiness

The studies discussed above examined SMEs across a variety of business and industry sectors. However, the bulk of past SME research has either ignored agribusinesses or, in the few instances when agricultural firms were included in a study, agribusinesses typically comprised a very small segment of subjects studied. Precisely because some

research indicates industry differences in ICT usage, researchers must delve more deeply into individual industries, sectors, and sub-sectors to understand when and how differences pertain.

For instance, in a six-year longitudinal study UK farm operators used computers and the Internet more as time passed [25]. Computer use increased from 50% in 1997 to 68% in 2003. Email use increased sevenfold and online banking increased fivefold in the six years. Similarly the study reports large increases in the use of the Internet for purchasing and for contacting customers. Interestingly, use of the Internet for farmer-to-farmer communication remained quite low over the study period. In a survey of Ohio farm operators computer adoption increased with firm size and operator education [3]. Batte [3] also found that operators from larger firms rated computer technologies used for financial recordkeeping as more useful. However, operators did not rate computers as significantly more useful when associated with Internet buying, selling, banking or information gathering. Park and Mishra [17] report that farm businesses are using the Internet increasingly more for various types of information gathering. Their results indicate that farm size, operator education level and farm diversification determine number of Internet technologies used.

2. Research Objectives

Due to the relative dearth of prior research regarding specific SME agribusiness sector-specific ICT use, the present study focuses specifically on ICT use by SME agribusinesses operating in the following industry sectors: tropical flowers, fruits and vegetables, plants and foliage, macadamia nuts and coffee (note: due to the geographical distribution of the survey, coffee growers are underrepresented in this particular survey). The ICTs of interest include email, online research, websites, and newer social technologies like instant messaging, chat, blogs, podcasts, etc. Hence, the paper examines the relationship of firm size, farm product type, and operator education to the adoption, use and evaluation of these various Internet technologies.

This study is motivated by four objectives. To begin, this study is primarily inspired by the rapidly changing nature of ICT development. This evolutionary context suggests that usage of ICTs will exhibit correspondingly dynamic patterns. For example it is likely that some ICTs will achieve quicker and more extensive diffusion than other ICTs. Thus, for research to be appropriately informed we need to capture and study pictures of the ICT environment frequently (perhaps even continuously). Toward that end this study aims first to describe, in as much detail as possible, the current state of ICT usage by SME agribusinesses in a particular geographical region. Of particular interest is determining the nature of SME agribusiness' use of the newest ICTs (e.g., instant messaging, chat, blogs, podcasts, etc.) as a baseline for future investigations.

The second objective in this study is to examine the relationship of SME size with the firm's adoption of a variety of ICTs including computers, email, websites, online research, and several social Internet technologies as described above. This paper takes the perspective that one of the most essential factors driving ICT adoption centers on a 'needs based' theoretical approach. Rather than acquiring systems as a function of the availability of resources—financial, human, etc.—small firms become more motivated to obtain information technologies as they experience the need for more efficient and sophisticated information management, largely as a function of growth in size. Complexity is a function of size. In other words, larger organizations become more complex to manage, requiring more complex information capture and access strategies, entailing greater reliance on information systems.

Mintzberg [15] argues that increased size in an organization leads to more job specialization, which in turn leads to greater differentiation between units in the firm. These differences require greater attention to inter-unit coordination, with correspondingly more formalization of behaviors and hence greater formalization (structuring) of the information accompanying these behaviors. Consequently, larger business in general can be expected to require more complex information management planning, strategies, policies, and systems. Conversely, smaller firms exhibit less need for information structuring.

In addition to intra-firm coordination for operational purposes, as a business grows in size, it is also required to coordinate business functions—from order processing to accounting—with greater numbers of customers and suppliers. Growth also requires managing more employees, entailing more administrative support for functions like training. Growth in size places an increased burden in all areas of an organization's operation for more effective and

efficient information management, which in turn results in greater likelihood of SBIS acquisition, including both Internet and non-Internet applications.

Kagan [13] reports that firm size is positively related to the sophistication of hardware and software systems used by agribusinesses. Because the Kagan study included businesses with over 500 employees, those results don't tell us whether size affects ICT usage differently when looking at only SMEs. The present study aims to address that issue by examining SMEs exclusively.

This study's third objective investigates whether the type of crop an SME produces bears any relationship on the firm's decision to use the various ICTs listed. One perspective looks at differences across industries in the amount of information intensity exhibited by the primary business activities. Information intensity refers to the degree to which information is present in a business' primary product or service. For instance, we might expect manufacturing to require more processing of information about the specifications of the product made than retail would require about merchandise sold. No significant relationship was observed between information intensity and likelihood of ICT adoption, although it was significantly related to extent of adoption [23]. One prior study showed an association between industry differences and ICT use specifically among agribusiness [13]. Additionally, different industries and industry sectors exhibit differential customer characteristics. For example, some industry sectors exhibit high growth requiring shortening life-cycles for the firms to remain competitive. This sort of innovative context can necessitate more intensive e-business engagement than with low growth sectors [8]. Thus, this study examines the relationship between crop type and ICT use specifically in agribusiness SME's.

Lastly, this study seeks to determine whether an agribusiness operator's education level impacts his or her firm's ICT adoption. Because small businesses are typically highly centralized, the CEO plays an important role in all aspects of organization and operations. Such a degree of involvement and influence affects decisions to use information technologies. For example, CEO age and experience have been noted as important factors driving ICT success [18]. However, the CEO's role in ICT adoption is not so clear-cut. For instance, CEO characteristics like knowledge of ICTs had no impact on either likelihood or extent of adoption [23]. Though it seems reasonable to assume the CEO is important in ICT adoption, research indicates that perhaps some CEO characteristics—like experience—exert more influence than others—like IT expertise. Level of end-user education is significantly related to ICT satisfaction, although no significant relationship between education level and use was found [9]. In that study however, end-users were workers in the general company population. In the current study, farm operators in smaller agribusinesses are seen as taking the role of end-users. More educated operators are more likely to have been exposed to computers during advanced education courses. More computer exposure combined with the influence an operator exerts suggests greater likelihood of computer adoption throughout the firm. Hence, computer use of all kinds is expected to increase with the farmer's level of education. In that regard, and counter to Foong's results, Batte [3] found that education was positively associated with computer adoption in a regional sample of agribusinesses. The present study seeks to try to reconcile the contrasting findings in the context of regional agribusinesses.

3. Method

The intent of the survey was to gauge the extent to which SME farming businesses are currently making use of or intend to make use of Internet technologies, including e-commerce, in support of their business operations. This survey is the second in a series of surveys aimed at better understanding Internet and e-business technology adoption across various sectors of Hawaii's SME agricultural industry. By better understanding current adoption patterns and intentions, this research hopes to provide a framework for planning future educational and support services for Hawaii's SME agribusiness.

Questionnaires were mailed out to 422 clients of USDA Agricultural Extension Services. These clients are farm businesses located on the Big Island of Hawaii including flower growers, fruit and vegetable farmers, plant and foliage growers, and those farming other crops like coffee, macadamia nuts, etc. The questionnaire was adapted from a 2001 NFIB survey and was used initially in a 2005 survey (results reported in Burke [5]). Follow up requests were mailed out several weeks after the initial mailing. Of the 422 questionnaires mailed out, 109 usable surveys were returned for a response rate of 26%.

With regard to non-response bias, it is presumed that late respondents exhibit characteristics similar to non-respondents [1]. One way to assess non-response bias is by comparing characteristics from early and late respondents. This study compared four respondent characteristics: two firm characteristics (firm size and type of product/crop sold), one farm operator characteristic (education level) and one technology characteristic (duration of website ownership). No significant differences were exhibited between late and early respondents for all four characteristics using single-tail *t*-tests at the 0.05 significance level.

Measures reported here include use of computers in the business, use of the Internet, use of email to communicate with suppliers or customers, online purchasing, online banking, online contracting, online research, ownership of a website, use of website for sales, percentage of website sales to total sales, benefits of the website (various), reasons for not developing a website, and use of social technologies (i.e., instant messaging, chat, email lists, discussion forums, blogs, podcasts, wikis). Due to the extremely small sizes of some businesses, many with just a couple of employees, this study is interested in whether they use the ICT or not, rather than the extent to which the ICT is deployed (for instance, number of employees using email) or the complexity of systems adopted (software sophistication). Therefore, all dependant variables were operationalized dichotomously—‘yes’ or ‘no’. Hierarchical logistic regression was used to test for overall model effectiveness, entering predictor variables in blocks so as to determine the incremental amounts of explained variance due to each of the variables in the model. Logistic regression is the appropriate test since the dependent variables are dichotomous. The independent variables in the regression are presented below in Table 1.

Table 1. Independent variables entered into regression

Firm size (continuous)
Product type (categorical – 9)
1. Tropical flowers
2. Fruits and vegetables
3 Plants and foliage
4 Coffee
5. Macadamia nuts
6. Other
7. Tropical flowers + Fruits and vegetables
8. Tropical flowers + Plants and foliage
9. Fruits and vegetables + Plants and foliage
Education level (categorical – 5)
1. High school diploma/GED
2. Some college or an associate’s degree
3. Vocational or technical school degree
4. College diploma
5. Advanced or professional degree

4. Results and Discussion

Demographics

The farmers surveyed are an educated group: everyone had at least a high school diploma with over 90% having some level of education beyond high school (Table 2). Indeed, a substantial portion of these farmers (40%) possess college degrees. All of the businesses surveyed are considered small or medium sized (SME) with the vast majority being considered micro-enterprises (85%), employing ten or fewer people. Five of the firms surveyed employ more than 50 people. Most of the farmers grow tropical flowers (53%), with a large number growing plants / foliage (49%), and 11% producing fruits / vegetables. Only one farmer in this survey reported growing coffee, two reported producing macadamia nuts and 14% grow other crops. Percentages total to more than 100% since some farmers produce in multiple crop categories.

Table 2. Firm and operator demographics

What is your highest level of formal education?	n = 109
A. Did not complete high school	0%
B. High school diploma/GED	6%
C. Some college or an associate's degree	34%
D. Vocational or technical school degree	9%
E. College diploma	40%
F. Advanced or professional degree	16%
Including you, how many people work in your business?	107
=< 5 people	70%
6 – 10 people	15%
11 – 20 people	9%
21 – 50 people	1%
> 50 people	4%
Which of the following agricultural industries best describes your primary business activities?	n = 109
A. Tropical flowers	53%
B. Fruits and vegetables	11%
C. Plants and foliage	49%
D. Coffee	1%
E. Macadamia nuts	2%
F. Other	14%

General Computer Use

Among SME agricultural firms, use of computers seems to be the norm. Almost all of the SMEs surveyed, 88%, report using computers in their business operations. Moreover, a third of those not currently using computers plan to start using one in the next year. Those who don't use or plan to use computers for business generally report lack of perceived benefits of computer use (33%) or lack of technical knowledge (33%), though the absolute numbers are relatively small.

Internet Use

SME farmers in this study overwhelmingly use the Internet for business purposes (80%). Results are presented in Table 3. As with computer use, one third of SMEs not using the Internet plan to adopt its use within the next year. Internet use is an umbrella term covering such activities as email, online purchasing, online research, online banking, online bidding and of course website use. Website use will be covered more specifically in the next section.

Predictably, the most common use of the Internet is for email communication with customers and/or suppliers (91%). Email use was followed closely by business-related research (87%) and online purchasing of goods or services (83%). Interestingly about half of the SMEs responding reported conducting online financial activities, such as banking. The least reported online business activity was contract bidding, with only 12% of responding SMEs engaging in it.

In general, SME agribusinesses surveyed here have widely adopted the Internet for a variety of business-related activities. Reasons given by the 20% for not using the Internet are distributed as follows: approximately 8% see no benefit; about 4% lack appropriate infrastructure; 4% have not really thought about it; and about 2% report lack of technical knowledge. The biggest barrier preventing Internet adoption among these SMEs appears to be lack of perceived benefit. This perception may be due to several factors. For example a grower may supply only one shipper who is seen on a regular basis, rendering email unnecessary. Non-adoption may result from other reasons as well. For instance one respondent noted an intention to retire in a year, thus having no motivation to learn to use the various Internet technologies.

Table 3. Internet use

Are you and/or your employees using the Internet for business-related activities?	n = 109
Yes	80%
Do you expect that you and/or your employees will use the Internet for business-related activities within the next year? (If answered 'No' to #4)	n = 17
Yes	35%
What activities does your business conduct on the Internet?	n = 78
A. Use e-mail to communicate with customers or suppliers	91%
B. Purchase goods and/or services	83%
C. Conduct financial affairs, such as online banking	49%
D. Bid on contracts	12%
E. Gather business-related information, such as prices, new products and so forth	87%
Why don't you expect to have your business use the internet within the next year? Is it because you?	n = 10
A. Don't see any benefit	40%
B. Cost of service is too high	0%
C. Don't know how to do it	10%
D. Haven't really thought about it	20%
E. Infrastructure not yet available	20%

Web Site Ownership

While most SMEs surveyed employ the Internet in the conduct of various business activities, far fewer own websites. In fact, only 30% of these agribusinesses reported having a website (Table 4). While this percentage may seem low given the constant media hype about website use, the extent of adoption reflects fairly closely website ownership rates found in an examination of national survey data [5]. That study found about 35% of all small businesses reported having a website. Among the website owners in the current study, over two thirds of them have owned their website for more than four years, suggesting that these website owning farmers have been on the leading ICT edge for a while.

Table 4. Website ownership

Does your business have a web site?	n = 109
Yes	30%

How many months has your web site been operating?	n = 32
< 1 year	6%
1 – 2 years	9%
2 – 3 years	13%
3 – 4 years	3%
4 – 5 years	16%
5 - 10 years	47%
> 10 years	6%

When those SME's not having a website were asked whether they would develop one in the next year, 24% said yes and 34% indicated a possibility. Interestingly, a substantial number (42%) said they do not intend to develop a website in the next year.

In this survey the majority of SMEs reported not owning a website. The most common reasons cited for not owning a website were: haven't gotten around to it – 39%; lack of technical knowledge – 37%; product/service not suited to website sales – 33%; and the time required to develop and maintain a website – 26%. Cost was an issue for 13% of respondents. Approximately 11% of SME's owners reported not seeing enough potential benefit in owning a websites. About 9% reported lacking appropriate infrastructure, while 9% indicated that the degree of online competition discouraged investment. In general, the dominant impediments to website ownership appear to be motivational, technical knowledge, and perceived lack of suitability of the SME's product for website commerce. A thread common among these factors is their informational aspect. Thus, it is possible that better educational and consultancy programs could overcome the motivational, knowledge and perceptual biases agricultural SME's exhibit toward website ownership.

Web Site Use – Sales, Income and Perceived Benefits

Historically, strategic organizational information technology issues have largely been seen from a transaction-based perspective. For example, Bergeron and Raymond [4] presented a matrix of information systems for competitive advantage (ISCAs) which referred to suppliers, competitors and clients as targets of information used for strategic activities. Similarly, e-commerce has been seen from a transaction perspective. Researchers have described ecommerce business models as business-to-consumer (B2C), business-to-business (B2B), consumer-to-business (C2B) or consumer-to-consumer (C2C). Bailey and Bakos [2] categorize electronic markets into industrial (B2B) or consumer (B2C). This sort of approach suggests that information management is critical to facilitate transactions between a firm and its buyers and suppliers. The above approach to IS draws largely on the transaction cost theory of the firm, developed by organizational economists, such as Williamson [26] to explain how internalizing market functions can help firms gain competitive cost advantage.

It follows then that it is important to understand how SME's use websites and what benefits owning a website can generate. In this study, two-thirds of firms owning a website (22% of all firms) report selling goods or services via the website (Table 5). For many, owning a website leads to substantial trade with other business partners (the B2B ecommerce model). For example, a sizable number of SMEs with websites, about half, report that website sales to other businesses reflect more than 10% of their total firm sales. Indeed, for almost a quarter of them their website sales to business partners constitute more than half of total sales.

Similarly, owning a website appears to bring substantial revenue benefits as well. For instance, half of those with websites report that their website sales constitute more than 10% of total firm revenues. A full 35% of tem report that website sales reflect 25-50% of total revenues. Some (abut 8%) indicated that website sales were more than 50% of their overall sales. Expectations for website sales a year from now appear stable across SME's. In other words, respondents indicated that the current website-to-total-sales ratios would continue in the near future.

Websites can generate revenues directly, via website sales as discussed above, or indirectly. SMEs in the current study reported a number of revenue channels in addition to direct sales as a result of their websites. For instance, 90% of website owners reported sales stimulated by the website but transacted via phone, fax or email. About half of

SMEs here also reported that their website stimulated people to come into the place of business to buy products. Additionally, a small number (10%) make money from advertisements on their website.

Table 5. Website sales

Do you sell goods or services directly over the web site?	109
Yes	22%
Approximately what percentage of your internet sales are to other businesses?	18
< 10%	50%
10 – 25%	11%
26 – 50%	17%
51 – 75%	6%
> 75%	17%
Approximately what percent of your CURRENT total sales do you make, directly or indirectly, as a result of your web site?	n = 23
< 10%	39%
10 – 25%	17%
26 – 50%	35%
51 – 75%	4%
> 75%	4%

It is important for SME owners and managers to be able to identify strategic benefits from their IT investments. For example, does an investment in a technology help generate an increase in a firm’s market share? Or can the investment make a firm’s business processes more efficient? These are questions that SME owners must ask when assessing the potential and actual benefits from a costly investment in IT, like developing a website. Results from the current study suggest that a number of significant strategic benefits accrue to SME agribusiness website ownership. For instance, a substantial number in the current study (80%) say their website has brought them additional customers (Table 6). Significantly, two thirds indicate that the website has brought them new types of customers, types not typically attracted to their traditional location. Most websites (73%) have generated an increase in total sales for their firms.

As pointed out at the beginning of this section, a major claim for ecommerce is the potential to reduce transaction costs. Indeed, 20% of firms here reported a reduction in costs per unit sold. More generally, 37% of firms report increased profits and 20% say their website has increased their sales in the international arena. Finally, the majority of SMEs owning a website (53%) indicate that their overall competitive position has improved because of their website. Evidence suggests that SME agribusiness owners who choose to invest in a website realize significant benefits generated from the site, and, more importantly, recognize those benefits.

Table 6. Website Income and Benefits

Does the web site produce income for your business through?	n = 30
A. Sales stimulated by the site, but made over the telephone, fax or e-mail	90%
B. Sales stimulated by the site, but made in your place of business	50%
C. Ads on your site	10%
D. Paid subscriptions to the material on your site	0%
E. Commissions for directing business to another site	0%

F. Any other way?	3%
To date, what benefits has your business experienced from your web site? Has it?	n = 30
A. Increased your total sales	73%
B. Brought you additional customers	80%
C. Brought you new types of customers	67%
D. Reduced your costs per unit sold	20%
E. Increased business profits	37%
F. Increased sales outside the United States	20%
G. Improved your competitive position	53%

The above discussion begs the question: Why do one third of SMEs with a website not sell via the site? The overwhelming majority (67%) say that their products or services are not suited to selling on the site. Some report that they have not gotten around to it yet (25%), while a few (17%) indicate that the cost is too high. So, while most websites generate sales with corresponding profits and benefits for their owners, some SMEs own websites to advertise their business or product but don't conduct transactions via the site. Generally most agribusiness SMEs that fall into this latter group feel that although the Internet is good for marketing, their product is not suitable for online selling.

Social Technologies

Steinfeld [21] argues that technology-based systems need to incorporate social processes. Huysmann & Wulf [10] go so far as to argue that electronic networks cannot survive without a corresponding and co-existing social network. Some suggest that members in a *community of practice* learn through participation in that community and that the boundaries of the community are determined by the task(s) the members share in common, the culture, and the history of the community [25]. Members in the community share their understanding and expertise with other members, embedding knowledge in the network for later re-use and reconstruction as a resource in problem solving. This new approach to knowledge management has been characterized as a community networking model, envisioning a task-oriented community where knowledge is not so much processed as it is continuously re-created and re-constructed through dynamic, interactive, and social networking activity [22]. This perspective in business suggests the need for SME agribusinesses to adopt and use a variety of emerging social networking technologies. Because standard point-to-point email has been available for decades and because of its relative prevalence, we examine its use separately. For our discussion regarding the use of newer emerging social networking technologies we include instant messaging, chat, email lists, online forums, blogs, podcasts and wikis (online information repositories where primarily text-based content is created by contributing visitors).

Results from the present study indicate that some agribusiness SMEs use some of the newer social technologies (Table 7). With the exception of email lists however, the extent of social technology adoption is relatively minimal at this date. Responses indicate that email lists are used by 43% of SMEs in this study. The other social technologies are used by only a few firms. The percent of all survey respondents reporting usage of a social technology are as follows: instant messaging – 8%; chat – 7%; online discussion forums – 9%; blogs – 4%; podcasts – 4%; and wikis – 1%. Significantly, almost half of the firms (47%) report using none of the technologies. In other words, a very small number of SMEs here use a variety of social technologies, while many use none. Quite a few, however, do use email lists.

Table 7. Social technologies

Are you or your employees using any of the following communication technologies for business-related activities?	n = 109
A. Instant messaging	8%
B. Chat	7%

C. Email lists	43%
D. Online discussion forums	9%
E. Blogs	4%
F. Podcasts	4%
G. Wikis	1%
F. We use none of the above.	47%

Firm Size, Product Type and Operator Education

Results from this study indicate that firm size impacts some ICT adoption but has no apparent effect on the adoption of others. Results show firm size is significantly associated with the use of computers in business, owning a website, and the use of a number of social ICTs. Table 8 below presents results from selected regressions for firm size. The informative statistic to look at when interpreting logistic regression results is the $exp(B)$. This statistic is an indicator of the change in odds of a dependent variable value occurring as a result of a unit change in the predictor variable. For example, the odds of a larger business using a computer are about four times greater than a smaller business ($p=.01$, $exp(B)=3.96$). These results are consistent with earlier research, e.g., [3] [17]. Website ownership also appears to vary depending on firm size. In this study, the odds of a larger farm owning a website were almost 20% higher than the odds of a smaller farm owning one ($p=.01$, $exp(B)=1.18$). This result is consistent with earlier conclusions that larger firms are more likely to adopt more sophisticated applications than smaller ones [12].

Table 8. Selected regression results - Firm size

Dependent variables	Wald statistic (p-value)	Cox & Snell R^2 Nagelkerke R^2	$exp(B)$
<i>Use computer for business</i>	6.83 (.01)*	.33 .64	3.96
<i>Use Internet for business</i>	2.30 (.12)	.21 .37	1.21
Activities conducted on Internet:			
<i>Email</i>	2.25 (.13)	.23 .51	1.54
<i>Purchase goods / services</i>	.17 (.68)	.20 .33	1.02
<i>Financial affairs</i>	.86 (.35)	.20 .27	1.02
<i>Bid on contracts</i>	1.82 (.17)	.23 .45	1.04
<i>Business-related research</i>	1.55 (.21)	.16 .29	.96
<i>Website ownership</i>	5.55 (.01)*	.33 .45	1.18
<i>Duration of website ownership</i> (univariate regression)	F = 1.49 (.42)	adjusted R^2 - .30	na
<i>Sell via website</i>	0.47 (.48)	.44 .63	1.09
Use following social technologies:			
<i>Instant messaging</i>	4.37 (.03)*	.10 .24	1.05
<i>Chat</i>	4.06 (.04)*	.13 .34	1.06
<i>Email lists</i>	4.46 (.03)*	.24 .33	1.11
<i>Online discussion forums</i>	0.17 (.67)	.03 .13	.96
<i>Blogs</i>	2.76 (.09)**	.16 .57	.35
<i>Podcasts</i>	0.50 (.47)	.11 .40	.82
<i>Wikis</i>	na		
<i>None of these social technologies</i>	4.28 (.03)*	.24 .32	.88
* significant at $\alpha = .05$ ** significant at $\alpha = .10$			

Kagan's results also suggest that larger firms should be more likely to develop more sophisticated and hence more complex websites. For example, larger firms would be expected to evolve from having a brochure-ware site that merely informs visitors to developing a site that allows the visitor to purchase the product. Interestingly, while firm size was found to affect website ownership in this study, size was not related to whether or not a firm sells its product via the website. There were no significant differences between smaller and larger farms in their decision to sell product from their web site.

Other results from the current study also contrast with those from earlier reports. For example prior studies suggest that ICT use is influenced by product type [23] and operator education [3]. In this study, neither product type nor operator education level significantly impacted adoption of any of the ICTs examined here. A look at the demographics may help explain current results. With respect to product differences, in this study most firms produced flowers (cut and potted), fruits and vegetables, or plants. Although these products appear quite different, their market characteristics (e.g., distribution channels, customer segment, etc.) share commonalities that make them less different than when comparing other producer/grower firms like grain or seed. Channel and customer characteristic differences become more pronounced when comparing diverse sectors like livestock, food processors and professional agricultural services. For example, Fillis et al. [8] suggest that firms in high-growth and short-life-cycle industry sectors are expected to exhibit greater degrees of e-commerce adoption in order to remain competitive. In other words, it is important to understand sector differences and their potential role in determining ICT usage differences when trying to compare and generalize ICT use characteristics. The fact that there were no differences in ICT use across the product types in the current study likely reflects homogeneity in important market characteristics.

Similarly, results obtained in this study indicate that different levels of farm operator education do not result in different patterns of ICT use. Indeed, none of the ICT usage factors studied here was significantly associated with changes in education level. High school graduates were no less or more likely to use the internet, have a website, sell via the website, or use any of the social technologies than were operators with some college or those with college degrees. This result appears counter to Batte's [3] conclusion that operators with some post-high school education were more likely to use a computer. Current results indicate education does not impact ICT use while Batte's results suggest education does matter. Why the different conclusions? For one thing, it is not clear whether Batte's study included farmers who had not graduated high school. For instance, if the Batte study included high school dropouts, the educational levels would contrast more than in the present study where everyone had a high school degree. In other words, education could still matter but the greater homogeneity in education level achieved among farmers in the current study could be mitigating that relationship somewhat. Still, operators in the current study exhibited various levels of education, including some college, college degrees and even some graduate work, but nonetheless did not differ in ICT use. Another perspective is that as education level increases, the impact of education on ICT adoption may become less influential, giving way to the pressure of other more critical factors like firm size or product type.

Finally, it is worth pointing out that a number of other subsidiary ICT factors were examined. Aside from the specific issues discussed above, the survey solicited information about website sales as a percent of total sales, perceived benefits of the website (followed by a list of potential benefits), reasons for not having a website, and reasons for not selling via the website. For all of these dependent measures there were no differences observed among firms of different sizes, among firms in different product categories, or among firms whose operators had more education. For example, when asked what benefits their website had brought them, 80% of respondents reported it bringing new customers, 73% reported bringing additional sales, and 67% reported the website bringing in new types of customers. Regardless of firm size, product type or operator education, the firms all enjoyed these benefits equally. The same was true for the rest of the measures as well. None of the three factors of interest had any impact on any of the subsidiary measures in this study.

5. Conclusions and Implications

This study extends our knowledge about ICT adoption factors among SME agribusinesses in several respects. Much of the body of SME research to date has not looked specifically at agribusiness. Additionally, relatively few agribusiness studies examining ICT use have been produced recently. This study reports results from data captured

in late 2007; hence the results paint a very current picture of ICT use among farmers. Moreover, the current study focuses very particularly on a narrow agricultural sector: primarily targeting tropical flowers, fruits and vegetables, and plants / foliage, and to a lesser extent coffee and macadamia nuts. While this narrow focus can be considered a limitation of the study, it is also a strength in that we have surveyed a large portion of these specific sectors in this region. Generalizing these results would probably best be done when looking at agricultural markets that exhibit similar characteristics across several dimensions, including product type, customer type, and market structure. For example, it might be possible to compare website usage here to usage among farmers who grow products that, like flowers, require quality control, are perishable, can be shipped, can be sold directly to consumers, but can also be consolidated through grower-shippers. With appropriate channel and market consideration, the results presented in this paper can be useful in assessing technology issues in other agricultural sectors as well.

A related contribution of this paper is that results here suggest that a different and more coherent picture of ICT use emerges when looking at specific industry sectors and product types rather than lumping all types together as most prior studies have done. Past studies have indicated differences in ICT use across industry and product types. Results here indicate homogeneity in ICT use among product sectors exhibiting similar channel or market characteristics. Future research needs to look more closely at identifying pertinent channel and market factors.

While this study suggests that firm size does matter in the adoption and use of ICTs, firm size is likely only one of a number of factors, including technical and social characteristics. For instance, although we observed differences among firms in the adoption of emerging social ICTs, this study did not consider the role of social networking among SME farm operators as an adoption driver. Nor does this study explore ICT use factors after adoption. For example, while firm size affects ICT adoption, other factors like investment in human resources and organizational support (including financial resources) may be critical to the ongoing success of the ICT [19]. Researchers should investigate those kinds of issues among agribusiness SMEs as well.

Results here have implications for practitioners as well. Mehrtens, Cragg and Mills [14] found that, among other factors, SMEs adoption of Internet technologies is significantly driven by perceived benefits and pressure by customers and suppliers. Small farm operators can see that their competitors are using the Internet for business enhancements. Thus, farm operators need to understand why and how they too can use ICTs for their own benefit. In general, farmers in the product sectors studied here used computers and the internet for business activities. The most common online activities are email, business-related research, purchasing, and conducting financial affairs. While most farmers use the Internet, far fewer (only about 30%) have progressed to the use of websites, with only a third of those using their websites to sell their products. Farmers who don't have a website or don't sell via the site generally don't think their product is suited to online business or else don't perceive enough benefit. Those who do have websites and / or do sell from them generally report benefits in the form of more customers, more sales and more profits.

A major contribution of this study is that it also assessed the use of several emerging ICTs – technologies whose use in SME agribusinesses have not yet been studied. Results show that farm operators are beginning to use these newer ICTs. For example the study found that instant messaging, chat, online discussions and even blogs and podcasts are used by a small number of farm operators. Significantly, results indicate that almost half of SME operators do not use any of the emerging ICTs. The results observed here provide a baseline for future studies of SME agribusinesses (especially for emerging ICTs) and offer motivation for farm operators to continue exploring ICT use.

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