

Gregor, S., Menzies, D. and Rolfe, J. (2002). Influences on engagement in e-commerce in agribusiness:
An empirical study. ITiRA Conference, Rockhampton, 27-28 August, 285-296.

**INFLUENCES ON ENGAGEMENT IN E-COMMERCE IN AGRIBUSINESS:
AN EMPIRICAL STUDY**

Shirley Gregor
Australian National University
Australia

John Rolfe
Central Queensland University
Australia

Don Menzies
Australian National University
Australia

Gregor, Professor Shirley
Australian National University,
Canberra ACT 0200
email: Shirley.Gregor@anu.edu.au

Rolfe, Associate Professor John
Central Queensland University
Rockhampton QLD 4702
email: j.rolfe@cqu.edu.au

Menzies, Mr Don
Australian National University
C/- Capgrains Cooperative
PO Box 5826

Rockhampton QLD 4701
email: donm@CapGrains.com.au

INFLUENCES ON ENGAGEMENT IN E-COMMERCE IN AGRIBUSINESS: AN EMPIRICAL STUDY

ABSTRACT

This study investigated the influences on e-commerce adoption by farming enterprises. Of the 76 respondents to a survey of farming enterprises in Central Queensland, 72 (95%) were using a computer and 63 (83%) were using the Internet. The application with the highest rated value was Online Banking. There were differences among the different categories of Internet users. Non-users felt pressure to use the Internet, but were more concerned than users about the significance of the associated costs and security. The factors that discriminated significantly between the *High Use* group and other Internet users were the length of time they had been using the Internet, and the degree of pressure felt from their industry to adopt the technology.

KEY WORDS

Agribusiness, E-commerce, Technology adoption, Internet

INTRODUCTION

This paper reports on a study that examines the use of the Internet and the adoption of e-commerce in agribusiness. The aim of the study was to investigate the influences on the adoption of various forms of e-commerce and to identify which influences have the most significant impact.

Agriculture is a forgotten sector in the debate about the contribution of information technology to economic growth. For example, most studies of productivity changes in

an economy focus on the non-farm sector (Oliner and Sichel 2000, Brynjolfsson and Hitt 2000). Because information technology applications allow not just direct productivity changes, but also organisational changes, marketing and consumer relationship changes, and better control over supply chain management, the greatest benefits from adoption of information technology have tended to be at the manufacturing and service industry levels (Brynjolfsson and Hitt 2000). Agriculture, firmly in the primary industry sector, is generally assumed to have fewer gains to make from information technology.

However, the use of information technology by agriculture is rapidly expanding. In the United States, Just and Just (2001) report that the proportion of farmers who had access to the internet had risen from 13% in 1997 to 29% in 1999. By June 2000, 58% of Australian farms had computer access and 34% had Internet access (ABS 1999-2000). However, not all farmers use the access for production purposes. Mueller (2001) reports that in Germany, 78% of commercial farmers with Internet access use it for electronic banking, while 28% use it to purchase goods, and 19% use it for selling goods.

Farmers are notoriously conservative and cautious with new technology. The high rates of takeup indicate that a much larger group than the advanced innovators is coming to grips with the new technology. This suggests that farmers are gaining real benefits from using information technology, and they judge the benefits to be greater than the costs of time, money and frustration involved in getting to grips with a new technology.

However, there has been little work to identify and quantify these benefits and costs.

Identifying why farmers in Australia take up information technology is important for two reasons. The first is that if productivity can be improved from using information

technology, this might be an important way of achieving further growth in agriculture. Determining where opportunities lie for productivity gains, how they might be achieved, and what are the barriers and triggers for takeup of information technology are important questions related to this issue.

Previous surveys by business organizations and government agencies have identified a number of influences on the engagement in e-commerce of businesses in general.

Generally, however, these studies lack an underlying theoretical framework and do not build on the considerable body of literature on organizational and technological innovation. Our study is significant in that it is based on a model drawn from both prior theoretical work and also empirical studies.

The remainder of the paper proceeds as follows. The next section shows the model of influences on the adoption and use of e-commerce that underlies the study. The following sections describe the survey methodology employed and the results of the survey. The final section discusses the conclusions drawn from the study.

CONCEPTUAL BACKGROUND

The nature of e-commerce

Some understanding of what is meant by *e-commerce* was needed as a basis for this study. Unfortunately, there are many definitions of e-commerce and confusion about the different business models that can be employed in e-commerce. An OECD (1999) publication shows the effort needed to “compile definitions of e-commerce which are policy relevant and statistically feasible” (p. 4). The expert group set up by the OECD concluded:

Definitions of e-commerce given by various sources differ significantly. Some include all financial and commercial transactions that take place electronically, including electronic data interchange (EDI), electronic fund transfers (EFT) and all credit/debit card activity. Others limit electronic commerce to retail sales to consumers for which the transaction and payment take place on open networks like the Internet. The first type refers to forms of electronic commerce that have existed for decades and result in trillions of dollar worth of activity every day. The second type has existed for only a few years and is not yet very large (p. 8).

In this study we follow the suggestion by the OECD expert group that broader definitions of e-commerce can be used as long as those definitions are detailed enough, and disaggregate the various types of e-commerce. Thus, we allow different types of e-commerce to be identified, including communication activities (email), information acquisition (research, market and technical information), financial transactions (banking, share trading), and buying and selling on the Internet.

E-commerce can be regarded as an *innovation* that an enterprise can choose to adopt or not adopt. Note that we do not regard e-commerce as a single package that is adopted in an all-or-none form by the organization. Rather, consistent with Galliers and Swan (1999), we see e-commerce being adopted in a variety of ways by different organizations, with the organization choosing different forms of e-commerce that suit their organization and adapting the technology to suit their needs. For example, we might find e-mail being used by primary producers for a variety of purposes – for example, social communication or to exchange information about market prices and discussion on timing of buy/sell activities for stock.

One aspect of e-commerce as an innovation should be stressed. This aspect is the *networked* or *interactive* nature of the innovation. Interactive innovations involve communication among two or more parties (Rogers, 1995) and include technologies such as the telephone, fax, email, and various exchanges that occur in e-commerce such as EDI, EFT, and buy/sell processes. The interactive nature of the technology means that there is interdependence among the adoption decisions of the members of a system. The interactive technology is of little use to an individual enterprise unless other enterprises are also using the technology. Thus, a critical mass of adopters must adopt the technology before it has utility for the average enterprise in the system. It is for this reason that a component of the model introduced in the next section is the influences of the immediate industry environment in which an enterprise is situated.

General framework for e-commerce adoption

In previous work (Gregor and Johnston, 2001) it has been argued that studies of the adoption and use of networked technologies (such as e-commerce and interorganizational systems) require analysis of influences at three different levels. Enablers and inhibitors at the three levels include:

- *External environmental influences*, which includes government policies, economic conditions, technological change, physical environment and geography. These influences are mostly outside of the influence of the industry or enterprise that are the focus of study. Earl (1989) points out that governments are increasingly involved in IT, through legislation, law and policy.
- *Industry level influences* include pressures from trading partners and competitors, and enabling mechanisms provided by software providers,

standards bodies, trade organizations and presence of a critical mass of participants.

- *Enterprise level influences* include perceived benefits and organizational readiness (financial resources and technical knowledge), and management support.

Figure 1 shows the general dynamic model that underlies the current study. This model presents the influences on e-commerce adoption and use at the three levels described above. The model is based largely on the prior studies of Iacovou, Benbasat and Dexter (1995) and Chwelos, Benbasat and Dexter (2001). Differences are that influences have been identified at the level of the external environment, and that *security concerns* has been introduced as an organizational level influence. Concerns over security have been identified in a number of recent surveys as a significant factor affecting the uptake of e-commerce (Pacific Access, 2001).

The studies of Iacovou et al. (1995) and Chwelos et al. (1995) investigated the adoption of EDI, which was often used over private dedicated networks. Thus, security was perhaps of less concern than current forms of e-commerce that are carried out over the Internet, an open network.

The dynamic model shows that degree of Internet use/e-commerce adoption is expected to have outcomes in terms of impact or added value to the adopting organizations. Over time, both positive and negative experiences with technologies used will influence the perceptions of the enterprises involved (and perhaps the industry) in feedback loops and affect future adoption behaviour. Our current study is cross-sectional in nature, so these

feedback loops are not a focus of the study here. They will be examined, however, in further work.

The prior studies on which this model is based show the nature of the variables involved. Iacovou et al. (1995) studied the adoption of EDI by small organizations. They identified three major factors that influence the adoption of EDI by small firms. These factors were perceived benefits, organizational readiness, and external pressures to adopt. The applicability of their model was demonstrated in seven case studies. Perceived benefits refers to the perceived relative advantage of adopting the technology (Rogers, 1995). Organizational readiness was defined as “the availability of the needed organizational resource for adoption” (p. 467), and included economic costs and degree of technical knowledge. External pressure refers to pressures from trading partners and customer pressure/mandate. This study had as a dependent variable EDI impact, which was measured by the level of system integration of EDI.

A subsequent study by Chwelos et al..(2001) tested the model advanced in Iacovou et al. (1995) in a survey of senior managers’ intention to adopt EDI. All three determinants were found to be significant predictors of intent to adopt EDI, with external pressure and readiness being considerably more important than perceived benefits.

A study by Premkumar and Ramamurthy (1995) is also relevant to the model proposed, and a number of the scales in the current study were adapted from this work. These authors studied the adoption of interorganizational systems (EDI) and found that two interorganizational variables, internal need (perceived benefit) and top management support were found to distinguish firms with a proactive attitude to EDI adoption.

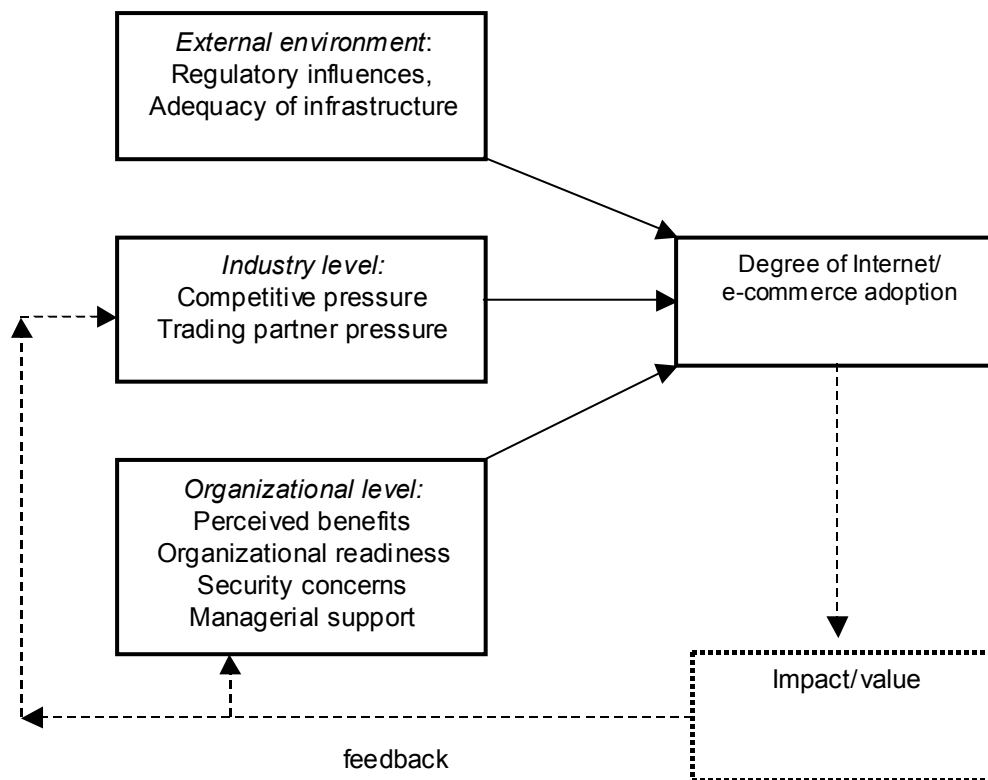


Figure 1: Model of influences on degree of Internet/e-commerce adoption

Previous surveys of influences on e-commerce adoption

Our study is concerned with factors influencing the adoption of e-commerce by farming enterprises. The majority of these farming enterprises can be classified as “small businesses”, using the Australian Bureau of Statistics definition of a small business as one which has 1-19 employees (ABS, 1999-2000). Thus, a number of studies that have investigated factors influencing the take-up of e-commerce in SMEs are of interest. There are a large number of such studies, though few employ any underlying general theoretical model (e.g. Corbitt and Kong, 2000; Poon and Swatman, 1997). Nevertheless, we would expect that significant factors found to affect uptake would be congruent with the model proposed in Figure 1.

The Pacific Access Yellow Pages survey (2001) reported on 1800 small-to-medium enterprises (SMEs) across a number of industry sectors in Australia. Agriculture was not included, though it represents 9% of all small businesses (ABS, 1999). This study found that 75% of small businesses were connected to the Internet. The top three uses of the Internet were: (i) to communicate via email (82%), (ii) to look for information about products or services (67%), and (iii) to get reference information or research data (65%).

With respect to e-commerce usage, the percentage of small businesses that placed orders over the Internet rose from 17% to 26% from 2000 to 2001. The percentage of small businesses that paid for products or services over the Internet doubled from 11% to 23% in the same time period. Small businesses recorded a rise in taking sales orders over the Internet from 14% to 19%.

The primary reasons given for engaging in e-commerce were: (i) to expand sales base (21%), (ii) to be more efficient (18%), and (iii) to keep up with competitors (17%). The five primary inhibitors of e-commerce adoption were:

- Lack of personal contact (39%)
- People able to hack into system (34%)
- Customers not prepared to transact on net (34%)
- A feeling that most of your customers aren't ready for e-commerce (33%)
- Lack of expertise and knowledge (28%).

The NOIE (2000) study found that security concerns were the primary barrier to online shopping. Lack of resources (18%) and initial set-up costs (12%) were barriers to business e-commerce adoption.

A survey by Groves and Da Rin (1999) is more directly relevant as it surveyed enterprises in the agricultural sector. The main use of the Internet was to obtain business information. Only 16% of respondents were using the Internet for purchasing, but this use was expected to grow, especially as security concerns were overcome. Few were using the Internet for selling, though some were using it to correspond with agents (31%). Other uses included teleworking, education and training, social and recreation and access to services such as justice, health, accounting, and extension.

The ABS (1999-2000) survey found that in the 12 months to March 1999, 72% of online farms regarded the provision of farm management or technical information and services on the Internet as important or very important, 68% reported online market information and services as important or very important and 65% reported online weather information as important or very important.

Gloy and Akridge (2000) studied the adoption of the Internet on large U.S. farms. They found that age and education strongly influenced Internet adoption. There were also strong relationships between Internet adoption, the sophistication of farm management practices employed and the complexity of the farm business.

SURVEY METHODOLOGY

The survey was constructed to gather data for farming enterprises on:

- computer and Internet use

- factors both contributing to, and inhibiting, adoption of the Internet
- value arising from use of computers and the Internet.

Where possible existing scales were used in the survey. The survey was designed to gather both quantitative and qualitative data, with some open-ended questions. A preliminary version of the survey was used in visits to three farming properties in April, 2001. Many of the questions were recast after these visits to give terminology that was more understandable by farmers. The wording of the form was refined and then tested in a pilot run with three producers in July 2001. Minor changes were made after this pilot run.

The list of potential respondents in central Queensland was compiled from several sources. These comprised lists of members of a grains cooperative (Capgrains Co-operative) and a beef marketing cooperative (Bluegum Beef), and lists of grains and beef producers supplied by the Department of Primary Industries (DPI). The DPI beef producers were taken from the Qld Tail Tag directory using the region of Central Queensland and could include any producer with greater than 11 head. The DPI grains producers were supplied by a DPI grain Extension Officer and were sourced from a list of producers subscribing to a DPI grains newsletter.

Potential respondents were selected at random from the lists, once duplicate entries had been removed. The following break-up reflects the source of the 197 respondents selected for the survey.

- DPI Beef List – 58 producers used (~50% of original list)
- DPI Grains List – 53 producers used (~75% of original list)

- Bluegum List – 40 producers used (~80% of original list)
- Capgrains List – 46 producers used (~66% of original list).

The survey was collected through a mail-out/telephone response format. All surveys were mailed out in batches of 20 per week from October to December 2001.

Respondents were contacted by telephone in the following week and asked if they would like to participate. Respondents could either complete the forms in their own time and return them by post, or could give the answers to the interviewer over the telephone. One of the researchers and a research assistant performed the mailout and the telephone interviews.

76 responses were received from 197 surveys issued. There were another 8% of respondents who indicated that they did not own a computer and that the survey was not relevant to them. Analysis is based on the 76 survey forms completed.

Table 1 shows how the explanatory variables of interest in our research model (Figure 1) were operationalized in the survey¹. The dependent variable in the study was “degree of adoption”. This variable was operationalized as a categorical variable with four values:

- *Non-use* - the enterprise was not using the Internet,
- *Basic use* – use of the Internet for basic purposes including email, information gathering, and social purposes but not buying or selling or financial services (banking/share trading),

¹ A copy of the survey is available from the authors on request.

- *Medium use* –use for financial services but not buying or selling,
- *High use* – use for buying or selling and financial services.

<i>Variable</i>	<i>Operational measure¹</i>
<i>Environmental influences</i>	
Regulatory influences	Pressure from quality assurance, GST, chemical reporting, natural resource management. Scale developed for this study.
Infrastructure adequacy	Adequacy of linespeed, connection reliability, ISP reliability, hosting services. Questions adapted from NOIE (2000).
<i>Industry level influences</i>	
Industry pressures	Pressures from trading partners, customers, marketing group, and competitors. Scale adapted from Iacovou et al. (1995) and Premkumar and Ramamurthy (1995).
<i>Organizational level influences</i>	
Perceived benefits (before adoption)	Advantages in more timely and better information for decision making, greater clerical efficiency (reduced paper work), improved service to customers, faster response time for goods ordered, better inventory control, reduced costs of operation, differentiation of services, improved competitive advantage Scale adapted from Premkumar and Ramamurthy (1995).
Cost significance	Significance of financial cost of computer and Internet access in terms of overall budget (single question).
Support/training	Assistance from workshops, friends, software suppliers, ISP, marketing groups, off-farm jobs, government programs. Scale developed for this study.
Internet experience	Length of time using Internet (years). Single question.
Security concerns	Email confidentiality, viruses, online payments, selling online, online banking, privacy. Scale developed for this study.

Note: ¹ Unless otherwise specified, all variables were measured on a 5 point scale from 1 (none/very low) to 5 (very high)

Table 1 Explanatory variables

Table 2 shows characteristics of the four groups. Analysis with ANOVA showed significant differences among the groups (Table 2). These differences support the operationalization of “degree of adoption”. The *High Use* group spent significantly more time using the Internet each week ($p < .001$) and used a greater number of applications ($p < .001$) than the other two groups of users.

Group	<i>Basic use</i> (<i>n</i> = 15)			<i>Medium use</i> (<i>n</i> = 20)			<i>High use</i> (<i>n</i> = 28)		
Characteristic	<i>Mean</i>	<i>Min</i>	<i>Max</i>	<i>Mean</i>	<i>Min</i>	<i>Max</i>	<i>Mean</i>	<i>Min</i>	<i>Max</i>
Internet use each week, 1 (once) to 4 (every day)	1.67 ¹	1	3	2.20 ¹	1	4	2.93 ²	1	4
Number of applications used	4.13 ¹	2	8	5.45 ²	2	8	9.54 ³	6	13

Note: ^{1,2,3} Superscripts indicate groups that differ significantly in post-hoc tests (LSD test, $p < .05$). Groups with the same superscript numeral are not significantly different.

Table 2 Differences among degree of adoption/use categories

RESULTS

Descriptive statistics

The largest group of enterprises surveyed by type of property were cattle producers (42%), with another significant group involved in both cattle and grain (37%). Only 12% were primarily grain, 9% cotton, 7% off-farm and some with other interests. The median value for length of time working in their industry was 26-30 years, with a range from less than 5 years to more than 40 years. The number of people employed in the enterprise ranged from 1 to 9, with a mean value of 3.3 people. The majority of the enterprises were family farms (97%).

Table 3 shows the number of enterprises with computers and Internet use.

Category	Frequency	Percentage
Using computer	72	95
Using Internet	63	83
Total	76	100

Table 3 Computer and Internet usage

These figures are higher than in other surveys. The ABS (1999-2000) shows 58% of farms using a computer and 34% using the Internet in June 2002. However, grain, sheep and beef cattle farming industries reported the lowest proportion of farms using

the Internet (31%). It is interesting that the rate in our survey is so much higher. The differences may be in part because of a response bias – at least 8% of surveys were not completed because the recipients did not have computers and felt the survey was not relevant to them. In addition, our survey is more recent than the ABS survey, and Internet usage is increasing very rapidly. The ABS survey showed a very rapid increase of 91% in the number of farms using the Internet over the 15 months to June 2000. If numbers roughly doubled again between June 2000 and our survey in late 2001, then the result would be approximately 62% of beef and grain enterprises using the Internet, which is closer to the result in our sample of 83% users. There is still a significant gap, however, which is not explained. Our figures are closer to the Yellow pages surveys (Pacific Access, 2001) showing 90% of small businesses using a computer and 75% using the Internet.

Table 4 shows the number of enterprises using the Internet for different purposes, and the value they placed on the individual activities. The highest uses were email, social and recreation and information gathering. Most value, however, was placed on banking.

Differences among Internet-user categories

Table 5 shows the mean values for the Internet-user groups for a number of variables. The majority of the variables were measured on 5-point Likert-types scales. All variables were treated as continuous in analysis (see Labowitz, 1970). Where analysis was repeated using non-parametric methods, the same significant differences were found.

	Nbr using	Frequency of responses for value ratings					Median value rating ¹
		Very low	Low	Medium	High	Very high	
Email	57	7	9	18	12	11	3
Social and recreation	53	20	9	15	9	0	2
Info - Technical	48	8	14	14	11	1	3
Info - Weather	47	8	10	12	13	4	3
Info - Market	47	9	10	16	9	3	3
Online banking	45	3	4	7	16	15	4
Education/training	35	6	10	14	2	3	3
Buying goods	31	9	10	10	2	0	2
Shares/investments	30	7	4	7	4	6	3
Selling goods	19	13	5	0	1	0	1
Feedback on product	10	2	1	5	1	0	3
Own web site	7	4	1	1	1	0	1.5
Teleworking	6	5	1	0	0	0	1
Other	3	0	1	0	0	1	3.5

Note: ¹ From 1 (low) to 5 (high)

Table 4 Ratings given for value of different uses of Internet (n = 63)

Group/ Characteristic	Non use (n = 13)	Basic use (n = 15)	Medium use (n = 20)	High use (n = 28)	p
Age - from 1 (less than 30 years) to 5 (60 years or greater)	3.62	2.80	3.42	2.93	.077
Education level – from 1 (primary school) to 6 (postgraduate)	2.31 ¹	2.80 ¹	2.79 ¹	3.75 ²	.006
Number of employees	3.45	2.40	2.37	2.48	.338
Gender - Frequencies for male (M) and female (F)	5M, 8F	6M, 8F	6M, 13 F	15M, 13F	-
Length of computer use (years)	5.39	6.55	6.95	8.25	.359
Computer use each week, 1 (once) to 4 (every day)	1.75 ¹	2.47 ¹	2.35 ¹	3.32 ²	.000
Internet use each week, 1 (once) to 4 (every day)	-	1.67 ¹	2.20 ¹	2.93 ²	.000
Value of computer use, 1(low) to 5 (high)	3.67 ¹	3.93 ¹	3.89 ¹	4.57 ²	.023
Value of Internet use, 1(low) to 5 (high)	-	2.47 ¹	3.05 ¹	3.96 ²	.000

Note: Mean values are given for each variable except for the frequencies for Gender. Superscripts indicate groups that differ significantly (LSD test, $p = .05$). Groups with the same superscript numeral are not significantly different.

Table 5 Comparison of user characteristics by Internet-user category

ANOVA was used to examine the differences among the groups. The *High Use* group had a significantly higher level of education than the other groups, used their computers and the Internet more each week and placed higher value on computer and Internet use.

Table 6 shows the differences among the Internet-user groups in terms of the influences on adoption that were specifically identified in our underlying adoption model (Figure 1). Enterprises that were not using the Internet showed significantly higher levels of concern over security and also indicated that the cost of computers and Internet access were of more importance than other groups. This group, however, also indicated that they felt significantly more pressure from regulatory bodies, their industry and perceived benefits in using the Internet. It appears that the pressures to adopt are not sufficient to overcome the disadvantages. Among groups using the Internet, the *High Use* category felt more industry pressure, had a greater length of time using the Internet, and had a higher level of concern over security.

Group/ Characteristic	Non use (n = 13)	Basic use (n = 15)	Medium use (n = 20)	High use (n = 28)	p
<i>External environment</i>					
Regulatory influences	2.69	1.77	1.72	2.05	.077
Adequacy of infrastructure	2.46	2.52	2.81	2.96	.432
<i>Industry level</i>					
Industry pressures	2.08 ¹	1.25 ²	1.26 ²	1.99 ³	.001
<i>Organizational level</i>					
Perceived benefits	2.64	1.82	1.95	2.41	.077
Cost significance	3.45 ¹	2.40 ²	2.37 ²	2.48 ²	.030
Internet experience	-	1.62 ¹	2.02 ¹	3.45 ²	.000
Security concerns	3.97 ¹	3.31 ^{1,2}	2.91 ²	3.13 ²	.035
Organizational support	2.64	2.43	2.07	2.52	.116

Note:

Superscripts indicate groups that differ significantly (LSD test, p = .05). Groups with the same superscript numeral are not significantly different.

Table 6 *Influences on adoption by Internet-user category*

COMPARATIVE ANALYSIS OF INFLUENCES ON ADOPTION

The analysis above compared the characteristics of the different categories of e-commerce adopters. We now use multivariate analysis to investigate which influences on adoption are the most significant.

Multivariate analysis of differences between users and non-users of the Internet was not performed because of the small number of cases in the non-user category, and the fact that several of these cases had missing values. Qualitative data was available from the 13 non-users' responses to the open-ended question: "What hinders/discourages or inhibits your from using the Internet?" Reasons given were: lack of time (3), linespeed no good (2), don't like computers (1), put off learning (1), not interested (1). The survey also asked "What might assist you to use the Internet?" Responses were: help from other people/lessons (3), nothing/not interested (2), better speed/equipment (2).

A logistic regression analysis was performed to investigate the relative importance of influences on adoption among the groups using the Internet. In this analysis the two groups "basic use" and "medium use" were merged to give larger group sizes and greater statistical power. Table 7 shows the comparison of the high adoption group (n=28) with the other adopters (basic/medium) (n = 35). The forward conditional entry method was used. In this analysis, only two of the influences in Table 6 have value in explaining the differences between high adopters and basic/medium adopters. These influences are Internet experience and industry pressures. Together these two factors predict category membership with 79% accuracy. Internet experience is the most important influence and gives 75% accuracy if used alone as a predictor.

Other factors which differed significantly between groups (eg education level) did not improve prediction when included in the model. Thus, the most important influences on degree of adoption are the length of time using the Internet (an indication of experience) and the degree of pressure felt from the immediate industry environment (from trading partners, customers, and marketing group).

	Coefficient	Standard Error	<i>p</i>
Intercept	--.176	.266	.508
Industry level influences			
Industry pressures	1.627	.631	.010
Organizational level influences			
Experience with Internet	1.103	.465	.018

Table 7 Logistic regression of influences on high adoption versus basic/medium adoption

CONCLUSIONS

This study investigated the influences on e-commerce adoption by farming enterprises. Underlying the study was a dynamic model of e-commerce adoption, which identified influences on e-commerce adoption at the levels of the enterprise, industry and the external environment. This model shows e-commerce being adopted in different forms by organizations, with feedback from the adoption of specific applications leading to impact/value to the enterprise, with effects on subsequent adoption.

Survey forms were sent to 197 farming enterprises in Central Queensland, mainly beef and grain properties. Of the 76 respondents, 72 (95%) were using a computer and 63 (83%) were using the Internet. These percentages are considerably higher than those for beef/grain properties in other surveys. Possibly this result is an indication of the very rapid growth in the use of the Internet over the last few years.

More than 50% of the farming enterprises were using the Internet for email, obtaining information (technical, weather, market), online banking, and education and training. A smaller number were using the Internet for buying/selling. The application with the highest rated value was Online Banking, possibly an indication of the savings in time and travel costs and increased convenience of Internet banking compared with trips to town to bank.

There were differences among the different categories of Internet users. Non-users felt pressure to use the Internet, but were more concerned than users about the significance of the associated costs and security. As in the study by Gloy and Akridge (2000) of farms in the U.S., the education level of the *High Use* group was significantly higher than for other groups.

In multivariate analysis, the factors that discriminated significantly between the *High Use* group and other Internet users was the length of time they had been using the Internet, and the degree of pressure felt from the industry. This finding is important, as no other survey has been identified that includes a variable measuring length of time using the Internet. In this study, this was by far the most significant factor affecting degree of uptake – other factors such as external environmental pressure, perceived need, significance of costs, support/training, and security concerns were not significant. It is this *High Use* group that uses their computers and the Internet more days each week, uses the greatest number of applications, and see most value in Internet use.

The implication of the study is that once farming enterprises begin using the Internet, initially for simpler applications such as email and obtaining information, they will see value in these applications, and will take on further applications in an incremental

process. The exact nature of this process appears to be a promising topic for further work.

REFERENCES

Australian Bureau of Statistics (ABS) (1999). *Small Business in Australia*, (Cat. No. 1321.0), Canberra

Australian Bureau of Statistics (ABS) (1999-2000). *Use of Information Technology on Farms, Australia*, (Cat. No. 8150.0), Canberra.

Brynjolfsson, E. and Hitt, L.M. (2000). Beyond computation: Information technology, organizational transformation and business performance, *Journal of Economic Perspectives*, 14(4):23-48.

Chwelos, P., Benbasat, I., and Dexter, A. (2001). Empirical test of an EDI adoption model, *Information Systems Research*, 12(3), 304-

Corbitt, B.J., and Kong, W. (2000). Issues affecting the implementation of electronic commerce in SMEs in Singapore, *13th Bled Electronic Commerce Conference*, Bled, Slovenia, June 19-21, 474-494.

Galliers, B. and Swan, J. (1999). Information systems and strategic change: A critical review of business process re-engineering, In W. Curry and B. Galliers (Eds.). *Rethinking Management Information Systems: An Interdisciplinary Perspective*, Oxford: Oxford University Press, 361-387.

Gloy, B.A. and Akridge, J.T. (2000). Drivers of Internet adoption on large U.S. farms and implications for agribusiness, Presented at 2000 IAMA World Food and Agribusiness Forum, Chicago, IL. (URL: <http://www.ifama.org/conferences/2000congress>).

Gregor, S. and Johnston, R.B. (2001). Theory of interorganizational systems: Industry structure and processes of change. In R. Sprague (Ed.), *Proceedings of the Thirty-Fourth Annual Hawaii International Conference on System Sciences (HICSS-34)*, Los Alamitos, CA: IEEE Computer Society, p. 159.

Groves, J. and Da Rin, J. (1999). *Economic & Social Impacts of Farm Internet Use*, Rural Industries and Development Corporation, Publication No 99/35, Barton, ACT.

Iacovou, C., Benbasat, I., and Dexter, A. (1995). Electronic data interchange and small organizations: Adoption and impact of technology, *MIS Quarterly*, No. Dec., 465-485.

Just, D.R. and Just, R.E. (2001). Harnessing the internet for farmers, *Choices*, second quarter 2001: 36-40.

Labowitz, S. (1970). The assignment of numbers to rank order categories. *American sociological review*, 35, 515-524.

Mueller, R.A.E. (2001). E-Commerce and Entrepreneurship in Agricultural Markets, *American Journal of Agricultural Economics*, 83(5):1243-1249.

Mukhopadhyay, T., Kekre, S. and Kalathur, S. (1995). Business value of information technology: A study of electronic data interchange, *MIS Quarterly*, June, 137-156.

NOIE (National Office of the Information Economy) (2000) *The current state of play November 2000* (www.noie.gov.au)

OECD (Organization for Economic Cooperation and Development) (1999). *Defining and measuring e-commerce: A status report*, Working Party on Indicators for the Information Society.

Oliner, S.D. and Sichel, D.E. (2000). The resurgence of growth in the late 1990s: Is information technology the story?, *Journal of Economic Perspectives*, 14(4):3-22.

Poon, S. and Swatman, P.M.C. (1997). Determinants of small business Internet usage: A multi-method investigation of perceived benefits, *Tenth International Bled Electronic Commerce Conference*, Bled, Slovenia, 9-11 June, 465-483.

Ragowsky, A. Ahituv, N. and Neumann, S. (2000). The benefits of using information systems, *Communications of the ACM*, 43(11), 303-311.

Rogers, E. M. (1995). *Diffusion of Innovations*. (4th edn.). New York: The Free Press.