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O. Chieochan
Charles Sturt University

D. Lindley
Charles Sturt University

Tim Dunn
Charles Sturt University

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Factors affecting the use of information technology in Thai agricultural cooperatives: a preliminary data analysis

Chieochan, O., Lindley, D., Dunn, T.
School of Information Studies, Charles Sturt University,
Locked Bag 675, Wagga Wagga, NSW 2678, AUSTRALIA.

Abstract

This paper presents a preliminary data analysis of factors affecting the use of information technology in Thai agricultural cooperatives. Factors in the internal environment (eg. manager and organizational characteristics) and the external environment (eg. competition, politics, economics, technology and infrastructure) of organizations are considered. The paper provides evidence that a Thai agricultural cooperative is more likely to use information technology if it has a manager who has a positive attitude towards information technology, is knowledgeable about information technology, is innovative, and is aware of economic, political, social, cultural and technological issues. Employee's information technology knowledge also influences information technology usage. Moreover, the size of a cooperative appears to be a factor with larger organizations more likely to use information technology than smaller organizations.

Keywords

Information technology, Thailand, agriculture, agricultural cooperatives

1. Introduction

The research project discussed in this paper aims to confirm and improve existing theories and research methodologies relevant to the innovation and use of information technology. It also aims to encourage the use of information technology in Thai agricultural cooperatives, which are a substantial part of the marketing infrastructure in the Thai agricultural sector (cooperative department promotion, 1993 and 1999).

Thong and Yap (1995) note that previous studies on the use of information technology by organizations tend to focus on organizational characteristics without giving due emphasis to the characteristics of individuals. Thong and Yap identify the significant role of an organization's decision-makers in the use of information technology. This paper shows that, besides individual and organizational factors, specific and general external environmental factors (ie. factors outside the control of the organizations and business owners) also influence the use of information technology in organizations.

Yap, Thong and Raman (1994), Thong and Yap (1995) and Thong (1996 and 1999) document information technology adoption in Southeast Asia. One finding is that variables found in developed nations may be different from those in developing nations. Similarly, Robey and Rodriguez-Diaz (1989) assert that culture can impede the implementation of information systems because of differences in the way the systems are interpreted and understood.

Information technology has been used in both developed and developing countries to support operational, tactical, and strategic processes within organizations (Abdulgader and Kozar, 1995) and some organizations are faster to introduce information technology than others. For

the purposes of this study, Thai agricultural cooperatives are considered slow adopters of information technology.

Literature relevant to this study is provided in Chieochan and Lindley (1999).

Key aspects of the literature underpinning our research approach, include:

1. The relationship between organizational characteristics and information technology
2. Previous research on similar topics including models of innovation and adoption

1.1 Information technology and organizations

Yap (1986) explains that it is difficult to establish the true relationship between information technology and organizations. He suggests that organizational factors may determine the use of information technology, or the use of information technology may influence an organization, or some combination of both.

Knowledge of the underlying organizational factors affecting the use of information technology, and the impact of information technology on organizations, is not only of academic interest, as it may also identify the way in which organizations benefit from information technology.

Many theories and models have been used by researchers to explain the inter-relationship of information technology and organizations. Robey and Zmud (1992), mention the following models:

1. The political conflict model, which introduces the concept of multiple objectives, held by different interest groups or stakeholders.
2. The organizational ecology model, which views organizational form as a result of external controls rather than proceeding from the decisions or preferences of organizational members.
3. The managerial innovation model, which argues that the adoption of new technology depends on awareness of problems and an organizational culture that encourage risk-taking.
4. The diffusion of innovations model, which argues that the spread of new technology depends on their application to their fit with work context, knowledge about the technology, technological infrastructure, and community beliefs about the technology. It was considered that the diffusion model (Rogers, 1983 and 1995) and adoption of innovations theory is more appropriate foundation for this research.

1.2 Research models

Thong and Yap (1995) and Thong (1999) note that the use of information technology is a form of technological innovation. Lakhanpal (1994), reviewing the literature on innovation in organizations, developed the framework in figure 1. It consists of the following four categories of relevant factors:

1. Individual-level factors
2. Organizational-level factors
3. Environmental factors
4. Characteristics of the innovation itself

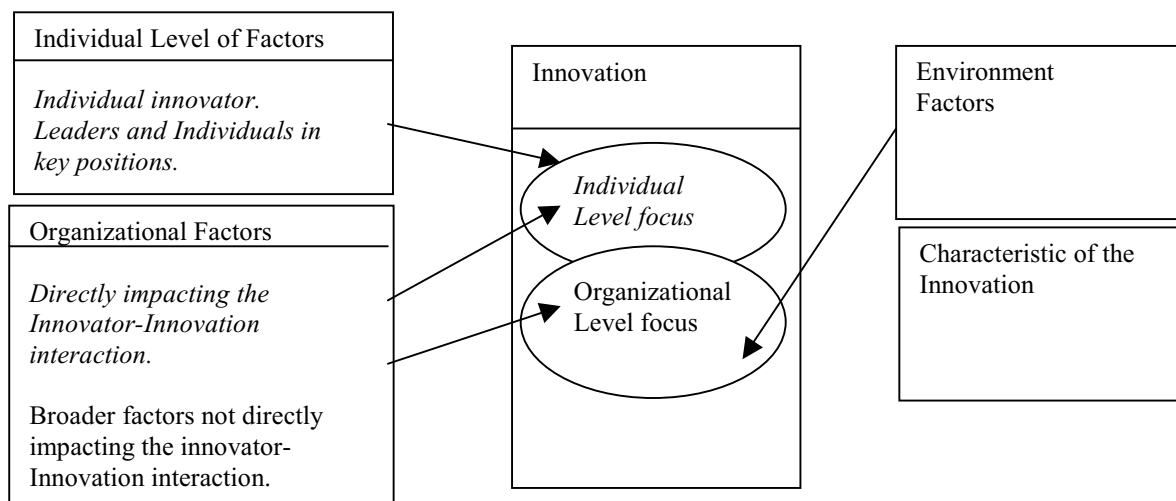


Figure 1. Factors from the innovation research tradition. Lakhanpal, B. (1994, pp.41).

1.2.1 Individual and organizational level factors

Individual level analyses investigate variables from two categories in Lakhanpal's framework (see figure 1).

1. Factors belonging to the individuals involved in the innovation process (both the innovator as well as leaders and other key positions).
2. A sub-set of organizational factors that directly affect the individual innovator's interaction with innovation.

Organizational level analyses, on the other hand, address the following (see Yap, 1990; Julien and Raymond, 1994; Hebert and Benbasat, 1994; and Wierenga and Ophuis, 1997);

1. Broader organizational factors that do not directly affect the individual adopter's interaction with the innovation,
2. Environmental factors, and
3. Characteristics of the innovation.

Thong and Yap (1995), in a study of individual and organizational factors within small businesses in Singapore, investigated three characteristics of chief executive officers (attitude toward adoption of IT, IT knowledge, and innovativeness), and three characteristics of organizations (business size, competitiveness of environment, and information intensity). Figure 2 is the model developed by Thong and Yap (1995). It is also the basis for the research project described in this paper. The findings of Thong and Yap are supported by Raymond (1990), Fink (1998), namely, that *both* individual and organizational factors can be important for the success of information systems within organizations.

CEO Characteristics

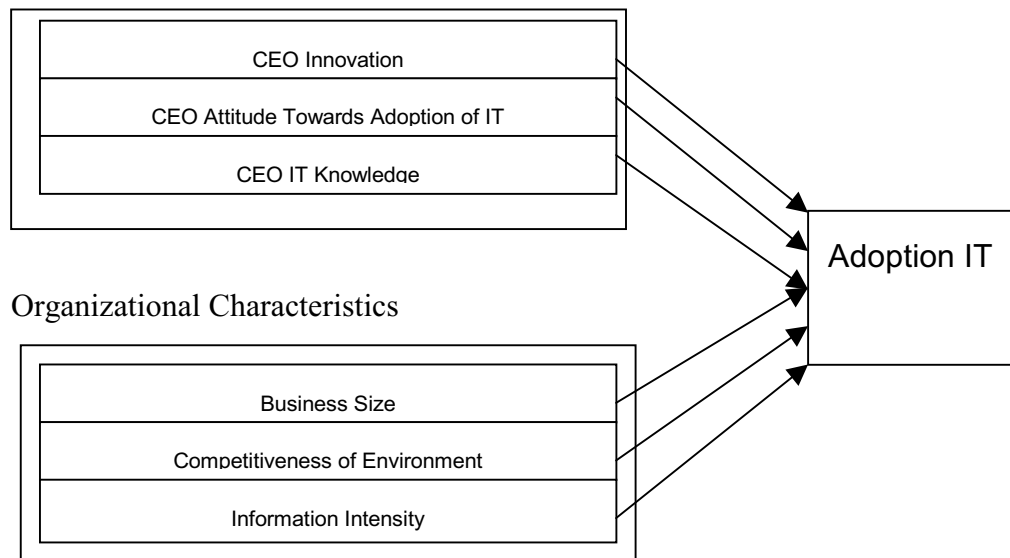


Figure 2. CEO characteristics, organizational characteristics and information technology adoption in small businesses (adapted from Thong and Yap (1995, pp.431))

1.2.2 Environment factors

Environmental factors are the third category of factors in Lakhanpal's framework (see figure 1). Calling them "external" factors (ie. factors outside the control of organizations and business owners), Yap (1986 and 1990) explains that there are two levels; "general" and "specific". *General* external factors include social, economic, political, legal and cultural factors; and *specific* external factors include customers, suppliers and competitors.

Johnson and Scholes (1993), Fry and Stone (1995), Hunger and Wheelen (1996), and Colthard, Howell and Clarke (1996) identify four general external factors; political, economic, social, and technological. However, because Thailand is classified as a developing country, in this study, economic and technological (ie. infrastructure) factors will be given greatest emphasis. Bazar, Ulaan and Boalch (1998) note that, in developing countries, there is often little technological infrastructure. The initial investment required for the introduction of information technology in developing countries will, therefore, be high, and the adoption rate low.

Yap (1986), Grover and Goslar (1993) and Fink (1998) provide examples of studies into specific external factors influencing the use of information technology in organizations.

Thong's (1999) work contains an integrated model, developed from work by Thong (1995 and 1996), of information technology adoption in businesses. The model includes characteristics of information technology and specific environmental characteristics, where the information technology characteristics used are relative advantage, compatibility, and complexity. Another factor, competition, is an example of a specific environmental characteristic. Thong's new model also includes refined the categories of information technology use; namely, likelihood of IT adoption (use or not use) and extent of IT adoption (light or intensive). Thong's new model is showed in figure 3. As discussed in Chieochan and Lindley (1999), general external factors such as social, economic, political, legal,

infrastructure and technology variables have not been studied, even though it seems reasonable that they might influence the use of information technology in organizations.

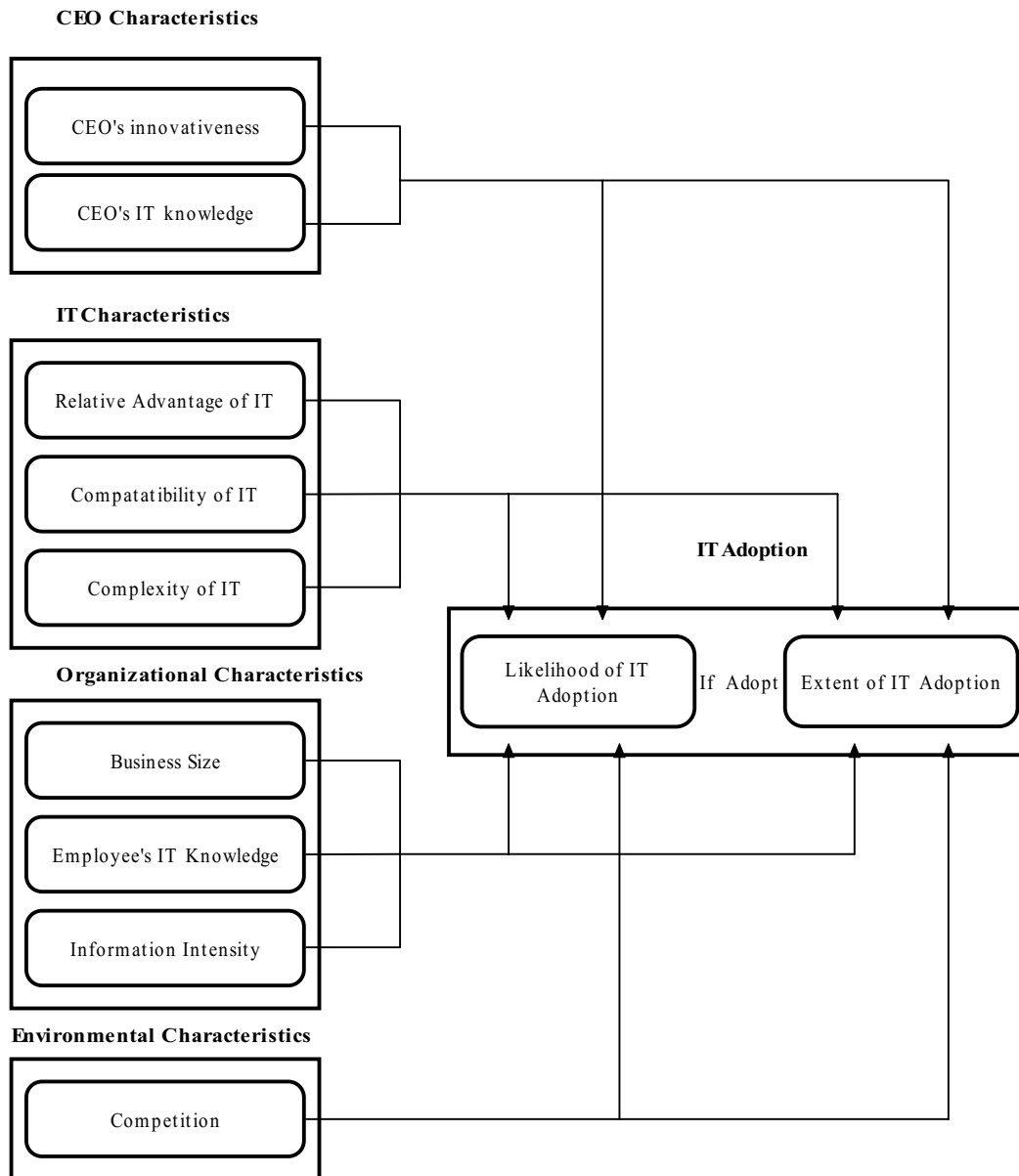


Figure 3. An Integrated Model of Information Systems Adoption in Small Business (Thong 1999, pp.193).

1.2.3 Characteristics of the innovation

The fourth category in Lakhanpal's framework (see figure 1) is characteristics of the innovation itself. Rogers (1983) work on the theory called diffusion of innovation is seminal in this area. The characteristic of an innovation and how this can influence adoption is a key feature. However, to fully appreciate Roger's theory researchers must understand all the factors that make up diffusion.

Diffusion is defined by Rogers (1983, pp.10 and 1995, pp. 10) as “the process by which an innovation is communicated through certain channels over time among the members of a social system”

An innovation, which maybe a process, object, or idea, must be perceived by an individual or an organization as being new. Rogers uses the terms (new) technology and innovation synonymously, but explains that technology is “a design for instrumental action that reduces the uncertainty in the cause-effect relationships involved in a desired outcome” (1983, pp.12 and 1995, pp.12)

There are 5 characteristics of an innovation, as described by Rogers (1983 and 1995), which may explain he results of our research:

1. Relative advantage, which is the degree to which a new idea is perceived as better or worse than the one it supersedes.
2. Compatibility, or the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters.
3. Complexity, which is the degree to which an innovation is perceived as easy or difficult to understand and use.
4. Trialability, or the degree to which an innovation may be experimented with by potential users on a limited basis.
5. Observability, which is the degree to which the results of an innovation are visible to others.

The model in figure 4 has been developed for the purposes of the study described in this paper. The model is based upon the work of Yap (1986), Thong and Yap (1995), Thong (1999), Johnson and Scholes (1993), Fry and Stone (1995), Hunger and Wheelen (1996), and Colthard, Howell and Clarke (1996).

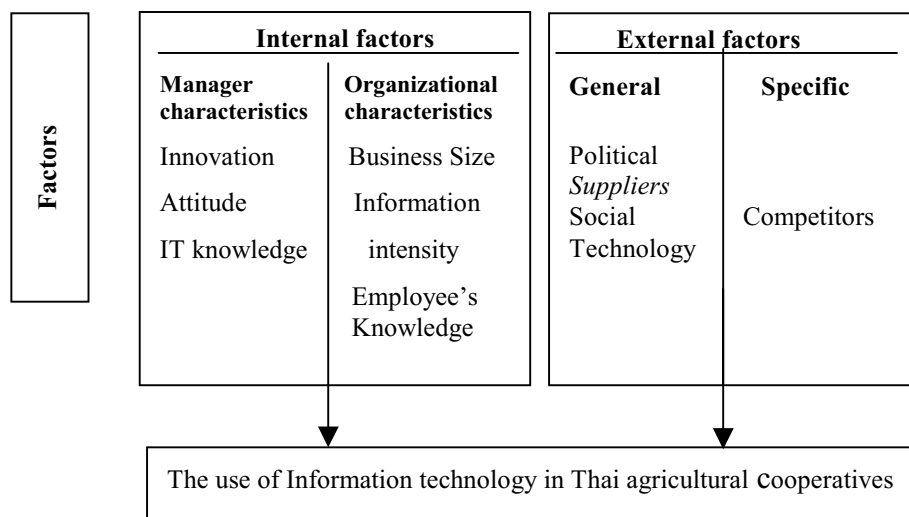


Figure 4. conceptual research model of factors affecting the use of information technology in Thai agricultural cooperatives

2. The research problem

Our research objectives are embraced in the following questions:

1. What factors affect the use of information technology in Thai agricultural cooperatives?
2. What characteristics differentiate Thai agricultural cooperatives that use information technology from those that do not?
3. Can a model be developed to explain the factors affecting the use of information technology in Thai agricultural cooperatives?

The methodological foundation for these research questions was formulated by 11 hypotheses (See table 1). Broadly speaking, these hypotheses are grouped as follows: numbers 1, 2, 3 and 6 relate to managers and employees, numbers 4 and 5 are internal factors about the organization, and hypotheses 7 and 11 are about external or environmental factors.

Table 1. Research hypotheses and associated findings from the literature

H1	Thai agricultural cooperatives with managers who are innovative are more likely to use information technology.	Thong and Yap (1995) and Thong (1996 and 1999) found that firms are more likely to adopt information technology when their CEOs are more innovative.
H2	Thai agricultural cooperatives with managers who have more positive attitude towards the use of information technology are more likely to use information technology.	Lakhanpal (1994), found that a middle manager's attitude towards microcomputer usage had a relatively positive influence on the adoption of microcomputers. Also Thong and Yap (1995) assert that CEOs who possess a positive attitude towards information technology are more likely to adopt information technology in their business.
H3	Thai agricultural cooperatives with managers who are more knowledgeable about information technology are likely to use information technology	Boynton, Zmud and Jacobs (1994) found that managerial information technology knowledge is a dominant factor in explaining the high level of information technology use in organizations. Similarly, Cragg and King (1993) note that the strongest factor inhibiting firms from adopting is a lack of knowledge of owners.
H4	Thai agricultural cooperatives that have a large in business size are more likely to use information technology.	Thong and Yap (1995) found that business size is the most significant discriminator in determining the use of information technology. Wierenga and Ophuis (1997) note that the size of organizations is positively related to adoption and innovation.
H5	Information intensity in Thai agricultural cooperatives influence the use of information technology in firms	Yap (1990) found that different organizations have different information processing needs, and those in more information intensive organizations are more likely to use IT than those in less information intensive organizations
H6	Thai agricultural cooperatives with employees who are more knowledgeable about information technology are likely to use information technology	Thong (1996 and 1999) documented that employee who have more knowledge of IT are more likely to use IT in their firms.
H7	Thai agricultural cooperatives that are more competitive environment are more likely to use information technology	Yap (1990), Fink (1998) showed that external environment, competition appears to be a major requirement for successful IT adoption in organizations.
H8	Thai agricultural cooperatives are influenced to use information technology by economic conditions in the country as a whole.	The National Science and Technology Development Agency (1997) reported that the economic crisis in Thailand affected not only the government sector, but also the business sector. This means that any kind of business in Thailand, including agricultural cooperatives, might be affected by an economic crisis.
H9	Thai agricultural cooperatives are influenced to use information technology by political.	Rodriguez (1994), Sanchez-Veegas (1995) reported that government is one of the factors that inhibit information technology in Latin America. For example, unstable government, excessive concern for secrecy and security, priorities are changed frequently, foreign intervention constant threat, centralization of political decision, impact of scientific approach minimal at the highest decision levels.

H 10	Thai agricultural cooperatives are influenced to use information technology by social-culture.	English is the dominant language for development of information technology. it is the second language in most Asian. Ang and loh (998), Coeur and Oliver (1997) noted that Language is one of the most barriers to the use of information technology in developing countries.
H 11	Thai agricultural cooperatives are influenced to use information technology by Infrastructure and technology.	The National Science and Technology Development Agency (1997) reported that the communication infrastructure in rural areas of Thailand is still poor and needs improvement. Also

3. Methodology

This section discusses the research methodology and design to be used in this research to discover factors affecting the use of information technology in Thai agricultural cooperatives. Bryman (1989) argues that research methodology is a key step in research, which supports research questions. Considerable care was taken in the development of variables, questionnaires, data collection, population and sampling, and data analysis and result.

3.1 Variables

Based on previous research, standard instruments were used as much as possible to examine data on internal organisational factors. The operationalization of additional research variables was developed for external factors. Rogers (1983 and 1995) explained that it means to transform research concepts into questions (or variables) that can be researched. Their developments are described in table 2.

Table 2. Variables in the study of factors affecting the use of information technology in Thai agricultural cooperatives.

Independent variables	Measurement	References
Manager characteristics		
Manager innovation:	Innovative Not innovative	Kirton 1976
Manager attitude to the use of Information Technology	Positive attitude forward using of information technology Negative attitude forward using of information technology	Moore and Benbasat 1991,
Manager's Information Technology knowledge	More knowledge Less knowledge	Thong and Yap 1995, Thong 1996, Thong 1999
Organizational characteristics		
Business Size:	Number of employees	Wierenga and Ophuis 1997, Thong and Yap 1995, Thong 1999, Raymond 1990
Information intensity	1. current of information 2. reliability of information 3. timeless of information	Thong and yap (1995), Thong (1996 and 1999)
Employee's IT knowledge	More knowledge Less knowledge	Thong (1996 and 1999)
External environment of organizations		
Specific		
Competitive environment	1. Ease for a customers to switch to a competitor 2. Level of rivalry among business in the same industry 3. Effect of substitutable products and service	Thong and yap (1995), Thong (1996 and 1999)
General		

Economic	Perception and awareness of managers to the economy	Johnson and Scholes (1993), Fry and Stone (1995), Hunger and Wheelen (1996), Colthard, Howell and Clarke (1996).
Policy	Perception and awareness of managers to the policy	Johnson and Scholes (1993), Fry and Stone (1995), Hunger and Wheelen (1996), Colthard, Howell and Clarke (1996).
Social-culture	Perception and awareness of managers to the social0culture	Johnson and Scholes (1993), Fry and Stone (1995), Hunger and Wheelen (1996), Colthard, Howell and Clarke (1996).
Infrastructure and technology	Perception and awareness of managers to infrastructure and technology	Rogers (1983), Johnson and Scholes (1993), Fry and Stone (1995), Hunger and Wheelen (1996), Colthard, Howell and Clarke (1996).
Dependent variables		
Use of Information Technology	The Use of information technology is divided into 2 levels. 1. Likelihood (use or not use) 2. Extent (light or intensive)	Yap 1986, Thong and Yap 1995, Thong 1996 and 1999

Notably, the adoption of information technology was measured by a question that asked whether a Thai agricultural cooperative was computerized or not. In comparison, Thong and Yap (1995), Thong (1996, 1999) operationalized their research with questions concerning the usages software applications such as accounting, inventory control, sales, purchasing, personal and payroll, CAD/CAM, EDI, MRP.

In our research, questionnaires comprised of approximately 100 questions divided into 4 sections. Sections 1 and 2 concerned general information about the managers and organizations. Sections 3 and 4 concerned internal and external factors respectively.

3.2 Data collection

Data were collected by a questionnaire mailed to managers of Thai agricultural cooperatives. Following Sarantakos (1998) the questionnaire used a five-point Likert scale with a range of responses from “strongly disagree” to “strongly agree”. In adopting this method we noted the work of other information systems researchers who used Likert scales, namely Tye Ng and Chanu (1994), Thong and Yap (1995), Thong (1996 and 1999), Gover, Goslar and Segars (1995).

The questionnaires were pretested using a semi-structured interview - enabling discussion of complex or ambiguous questions. Sarantakos (1998) and Lawrence and Keen (1996) recommended this as a way of improving question wording.

During the pretest, three types of people were interviewed, namely the head of the Information Technology Section, Ministry of Thai Agricultural Cooperatives, two Thai researchers and five Thai agricultural cooperative managers.

The modified questionnaires were then evaluated in a pilot test by sending them to 20 randomly selected managers of Thai agricultural cooperatives. Fourteen questionnaires were returned including 4 that were answered incompletely.

3.3 Population and sample

The names and addresses of Thai agricultural cooperatives will be obtained from the Cooperatives Promotion Department, Ministry of Thai Agriculture and Cooperatives. There are 3,398 Thai agricultural cooperatives with 4,659,373 members (Cooperatives Department promotion, Ministry of Thai Agriculture and Cooperatives, 1999, pp.1).

The criterion for dividing the size of Thai agricultural cooperatives is based on the number of members (farmers) and their size. Srisempook, (1993, pp. 21) classified Thai agricultural cooperatives three sizes. The largest size is 2,000 members or more, medium size is between 1,000 and 2,000 and the small size is where the members are less than 1,000.

A multistage sampling technique was used, namely systematic random sampling and stratified random sampling. Sproull (1995) noted that a 10 % sample is adequate. A sample of 454 cooperatives was drawn and 256 useable responses were obtained giving a 56 % response rate. According to Bailey (1982) this is adequate for an acceptable result. Table 3 and 4 shows the break down of responses across the sampling categories.

Table 3. Summary of the characteristics of the respondents

Manager characteristics	57 % were male, 46.5 % were 30 - 39 years old, 54.3 % held bachelor degrees, and 50 % had 5 to 10 years working in managerial positions in Thai agricultural cooperatives.
Organizational characteristics	48 % of Thai agricultural cooperatives were run as businesses for 21 to 30 years. 60 % used computers, and 4.6 % hooked up to the Internet. 43 % used software developed from the Thai Ministry of Agriculture and Cooperatives.

Table 4. Number of Thai agricultural cooperatives started using computers from 1995 to 1999

Organizational characteristics (Number of Thai agricultural cooperatives started using computers)	Years	Percentage of start using computers
		1995
	1996	20.8
	1997	18.9
	1998	9.7
	1999	3.9

3.4 Statistical analysis

Following Yap (1986), Thong and Yap (1995), Thong (1996 and 1999) 3 statistical tests were used, namely the T-test, Pearson correlation and discriminant analysis.

The research data were analyzed in two stages. First, two bivariate data analysis (t-test and Pearson correlation) was used for testing individual hypotheses. Second, the multivariate analysis (discriminant analysis) was used to study the effects of all independent variables simultaneously.

The first stage of data analysis, Morgan and Griego (1998) explained that t-test was used to compare the differences of mean between two groups: of Thai agricultural cooperatives using and not using information technology. Also, Morgan and Griego (1998) explained that Pearson correlation was used to test the correlation between independent and dependent variables (this is, the use or non-use information technology).

The second stage of data analysis used discriminant analysis. Morgan and Griego (1998) explained that this technique is to identify the combination of independent variables which best account for the statistically significant differences between Thai agricultural cooperative that use or not use information technology in their operations.

3.5 Results

The result of t-test, Pearson correlation, discriminant analysis and the table of the summary of the all results can be seen in table 5, 6, 7 and 8.

There are 11 hypotheses. 9 hypotheses are accepted (H1, H2, H3, H4, H6, H8, H9, H10 and H11). In general, our results support the studies from Thong and Yap (1995) and Thong (1996, 1999). It can be seen that manager and employee knowledge about information technology tested at the highest level of significant in explaining Thai agricultural cooperatives' use of information technology. Business size, information technology characteristics, social-culture, national economic, manager innovative, manager attitude towards the use of information technology and government policy also influence the use of information technology in Thai agricultural cooperatives.

In contrast, competitiveness of the environment or information intensity were not significant in explaining the use or non use of information technology.

Table 5. the result of T-test

Variables	Computerize (n = 153)		Non-computerize (n = 103)		T-test	
	Mean	SD	Mean	SD	T-value	2-tail ed. SIG
Internal environment of organizations						
Manger characteristics						
H1: Manger innovativeness	3.9208	0.3603	3.7782	0.3958	2.983	0.003**
H2: Manager attitude the use of information technology	3.9564	0.2857	3.8314	0.4106	2.872	0.004**
H3: manager's information technology knowledge	3.4211	1.2044	1.6832	1.0856	11.685	0.000**
Organizational characteristics						
H4: Business size	13.9865	11.2347	8.1474	8.3219	4.355	0.000**
H5: Information intensity	4.1324	0.6171	4.0995	0.4880	0.453	0.651
H6: employee's information technology knowledge	3.8121	0.4295	2.9201	0.9549	10.127	0.000**
External environment of organizations						
Specific						
H7: competitiveness of environment	3.4690	0.6691	3.3762	0.5331	1.117	0.240
General						
H8: Economic	3.5490	0.6865	3.6238	0.6510	3.404	0.001**
H9: Policy	3.3170	0.7418	3.1197	0.7462	2.081	0.038*
H10: Social-culture	3.9069	0.6570	3.6044	0.7561	3.398	0.001**
H11 infrastructure and technology						
H11.1 technology	4.1786	0.6283	3.9288	0.7693	2.848	0.005**
H11.2 infrastructure	3.5490	0.6865	3.6238	0.6510	0.872	0.384
H11.3 technology	2.0588	0.8754	2.5534	0.8909	4.401	0.000**

*Significant at $p < 0.05$, **significant at $p < 0.01$

Table 6. The result of Pearson correlation

Variable	Likelihood of the use of information technology	
Internal environment of organizations	Correlation coefficient	Significant
Manager characteristics		
H1: Manger innovativeness	0.184	0.003**
H2: Manager attitude the use of information technology	0.177	0.004**
H3: manager's information technology knowledge	0.594	0.000**
Organizational characteristics		
H4: Business size	0.270	0.000**
H5: Information intensity	-0.028	0.651
H6: employee's information technology knowledge	0.537	0.000**
External environment of organizations		
Specific		
H7: competitiveness of environment	0.074	0.240
General		
H8: Economic	0.209**	0.001**
H9: Policy	0.129*	0.038*
H10: Social-culture	0.209**	0.001**
H11: technology and infrastructure		
H11.1 technology	0.176	0.005**
H11.2 infrastructure	0.055	0.384
H11.3 infrastructure	0.266	0.000**

*Significant at $p < 0.05$, **significant at $p < 0.01$

Table 7. The result of discriminant analysis

Variables	Univariate F-test Probability	Significant	Standardized Canonical Coefficients	Structure Matrix: Pooled Within-groups Correlations
Internal environment of organizations				
Manager characteristics				
H1: Manager innovativeness	8.570	0.004**	0.085	0.171
H2: Manager attitude towards the use of IT	9.384	0.002**	0.259	0.179
H3: Manager's IT knowledge	116.313	0.000**	0.622	0.630
Organizational characteristics				
H4: Business size	18.628	0.000**	0.427	0.252
H5: information intensity	0.558	0.456	-0.15	0.044
H6: employee's IT knowledge	89.613	0.000**	0.495	0.553
External environment of organizations				
Specific				
H7: competitiveness environment	0.354	0.553	-0.280	0.035
General				
H8: economic	11.591	0.001**	0.244	0.199
H9: Policy	4.372	0.038*	0.160	0.122
H10: Social-culture	15.558	0.000**	0.263	0.231
H11 infrastructure and technology				
H11.1 technology	10.156	0.002**	0.019	0.186
H11.2 infrastructure	0.383	0.536	-0.259	-0.036
H11.3 technology	22.442	0.000**	0.114	0.277

*Significant at $p < 0.05$, **significant at $p < 0.01$

Table 8. Summary of data analysis

Variables influencing the use of information technology in Thai agricultural cooperatives descending from the highest to the lowest.					
order	Variables	Level			
		Internal		External	
		Individual	Organization	Specific	General
1	Manager's information technology knowledge	x			
2	Employee's information technology knowledge	x			
3	Business size		x		
4	Information technology characteristics (1)				x
5	Social-culture				x
6	Economic				x
7	Manager innovativeness	x			
8	Manager attitude towards the use of information technology	x			
9	Information technology characteristics (2)				x
10	Policy				x
Variables that do not influence the use of information technology in Thai agricultural cooperatives					
11	Infrastructure				x
12	Competitiveness of environment			x	
13	Information intensity		x		

4. Discussion

According to the research questions, this paper provides preliminary empirical evidence that the development of the new model can explain factors affecting the use of information. Those factors are presented and discussed below.

Managers' and employees' knowledge about Information technology is most important for the use information technology in Thai agricultural cooperatives. This finding is consistent with Attewell's theory of lowering knowledge barrier (Attewell, 1992).

Not surprisingly, business size influenced the use of information technology in Thai agricultural cooperatives. Organizations that are bigger in size are more likely to use IT. One explanation by Thong (1996) is that larger organizations usually have more organizational and financial resources and greater professional expertise.

Two sets of questions about IT characteristics (1 and 2) were used to test adoption theory (Rogers 1983) and the importance of external environmental factors as they relate to IT use in Thai agricultural cooperatives. The second set of questions was developed from the work of several authors who were concerned with government and industry spending for research and development on new technology, technological efforts and infrastructure (Johnson and Scholes, 1993; Fry and Stone, 1995; Hunger and Wheelen, 1996; and Colthard, Howell and Clarke, 1996). In comparison, Rogers' theory is concerned with factors internal to the organisation including relative advantage, compatibility, complexity, trialability, and observability of IT.

In general Rogers theory helps explain adoption of IT in terms of its characteristics as an innovation. Thus Rogers' theory may provide an explanation of IT adoption. However, the external factors that were expected to affect IT adoption were not correlated with its use. One explanation of these results is that managers of Thai agricultural cooperatives are more concerned with inherent IT characteristics (ie. relative advantages, compatibility, complexity, trialability, and observability) than they are with external factors such as research and development such as government and industry support and infrastructure.

Social and cultural factors can also affect the use of information technology. In this study, social and cultural factors included the English language barrier, and the attitude towards quality of working life (Johnson and Scholes, 1993; Fry and Stone, 1995; Hunger and Wheelen, 1996; Colthard, Howell and Clarke, 1996). IT can improve the quality of life for a manager and his/her employees and help people finish their jobs faster and more easily than with old methods.

In 1997, economic conditions in Thailand were difficult (Terdudomtham, 1998). Our study shows that the number of cooperatives using computers decreased respectively from 1997 to 1999 (see table 4). We believe that the economic crisis influenced the use of information technology in Thai agricultural cooperatives.

Managers of Thai agricultural cooperatives who are more innovative and have a positive attitude towards the use of information technology tend to use information technology in their organizations. This finding is consistent with Rogers' model of an individual's innovation-adoption process (Rogers, 1983 and 1995).

Policies from the Thai Royal Government and the Thai Ministry of Agriculture and Cooperatives, such as development and promotion of free software, attempted to influence the use of information technology in Thai agricultural cooperatives. In 1995, when the Thai government announced that it was the Year of Information Technology (Koanantakool, 1998), the number of Thai agricultural cooperatives starting to use computers was highest.

In contrast to expectations, a competitive business environment and increased information availability does not influence the use of information technology in Thai agricultural cooperatives. This agrees with the findings of Thong and Yap (1995), Thong (1996, 1999).

The same is true for information intensity. The information processing theory of Galbraith (1973) concerning the process through which the environment influences a business action explains that information intensity is the degree of information present in the products or services of business. Yap (1990) noted that different organizations have different information processing needs, and those in more information intensive organizations are more likely to use IT than those in less information intensive organizations. One way of explaining our results is to observe that all Thai agricultural cooperatives have similar information processing needs and that information concerning agricultural products alone, and members' records, does not warrant computerisation.

Methodological changes are worth nothing especially to the questionnaire and data analysis. The original questionnaire was developed for a Western culture and adapted for a Singaporean Chinese study by Thong and Yap (1995), Thong (1996 and 1999). We adapted these methods for a Thai culture and for a business context. From this experience we can recommend that pattern, format and wording should be considered when applying the questionnaire from one culture to another (Chieochan and Lindley, 1999). The use of statistical techniques, such as factor analysis to test the validity, and coefficient alpha to evaluate reliability of questionnaires was successful and we are confident that our methodology is sound.

5. Scope and Limitations of the Study

To understand our research it is necessary to appreciate the following assumptions and limitations:

1. The use of information technology benefits the operations of Thai agricultural cooperatives.
2. In formulating our approach we agreed with Babbie (1990) that science is parsimonious. Therefore it was not possible to study all factors that might influence organisational operations or technology adoption. Our work rigorously applied social science principles and survey methodology in an attempt to understand the operation of Thai agricultural cooperatives and their adoption behaviour. In particular we sought to reveal key internal and external variables that influenced the adoption (or non-adoption) of information technology.
3. Managers of Thai agricultural cooperatives were targeted in our survey. Despite the role of committees and other staff who might influence the use of information technology, it was beyond the scope of our study to include them.
4. Our project was a cross-sectional study. However, we recognized that time was important and a longitudinal study should be considered in future research - particularly to take account of changes in external environment.

Our research is largely quantitative - focusing on correlations between independent variables and dependent variables. However, we also recognise that indirect relationships may also be important and such possibilities are discussed.

6. Conclusion

This project set out to test and improve existing theories and methodologies in the research of information systems adoption in the Thai agricultural cooperatives. It also attempted to identify factors that could improve industry practice in agricultural organizations in nations like Thailand where there is a need to learn and change. This paper provides preliminary empirical evidence of the factors affecting the adoption and use of information technology in Thai agricultural cooperatives. Factors in the internal and external environment of organizations were studied. Factors from the internal environment are of 2 types; first, characteristics of managers such as attitude towards adoption of IT, IT knowledge, and innovation; and second, organizational characteristics such as business size, employee's IT knowledge and information intensity. Specific factors identified from the external environment include competitiveness. General factors from the external environment are politics, economics, society and culture, infrastructure and technology.

In summary, Thai Agricultural Cooperatives are more likely to use information technology when:

1. Managers and employees are knowledgeable about information technology.
2. Cooperatives are large in size
3. Managers are aware of technology and perceptive of social and cultural and economic conditions.
4. Managers are innovative.
5. Managers have a positive attitude towards the use of information technology.
6. Managers are aware and perceptive of policies from the Thai Royal Government and the Thai Ministry of Agriculture and Cooperatives.

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Authors' s Biographies

Oran Chieochan has a Bachelor of Science (Hons) degree from Rajamangala Institute of Technology, Thailand, a Master of Computing degree from Griffith University, Australia, and is currently studying towards a Ph.D. in the School of Information Studies, Charles Sturt University, Australia. His research interests focus on information technology in agricultural businesses and rural development in developing countries.

David Lindley has degrees in computing and information management and a Ph.D. from the University of New South Wales, Australia. He has approximately 15 years industrial experience and is presently an academic in the School of Information Studies, Charles Sturt University, Australia. He is also Chief Examiner of the Australian Computer Society and a consultant to IDP Education Australia. His principal research interest lies in the use of information technology for national economic and social development, especially in the countries of South and East Asia.

Tony Dunn has a Master of Agricultural Science from the University of Melbourne in Extension. He is a Senior Lecturer in extension and Agricultural Systems in the School of Agriculture at Charles Sturt University, Australia. His research interests are in the rural social sciences including the application of qualitative methodologies to improve agricultural use of natural resources and the social condition of rural people. Particular specialties include the application of methodologies like Soft Systems Methodology and Rapid/Participatory Rural Appraisal to assist change in rural social systems.