EXTENT AND PURPOSE OF ADOPTING ICT FOR AGRIBUSINESS DEVELOPMENT: THE CASE OF SAMPLED-FIRMS IN EAST JAVA

Sudaryanto[1] and Soekartawi[1]
[1]*University of Jember, Indonesia*
[2]*Brawijaya University, Malang, Indonesia*
e-mail: *ysudaryanto@students.ballarat.edu.au[1]; prof.soeka@gmail.com[2]; dr_soekartawi@yahoo.com[2]*

ABSTRACT

This article is a part of the first-author PhD-dissertation entitled 'Factors Influencing ICT Adoption in East Java Agribusiness: Individual and Organisational Approaches'. The main objective of presenting this article is sharing information related to investigation of ICT adoption done by samples who are asked to respond to a multiple response questions.

ICT adoption ladder model is used for the analysis. The samples are grouped into four level of adoption--- lowest to highest level), namely (i) ICT- Conventional, consists of fixed line phone, facsimile, and mobile phone, (ii) ICT- Computer, consists of stand alone computer with access to the internet via internet cafes, (iii) ICT-Internet, consists of use of the internet for email and using a web browser, and (iv) ICT-E-business, consists of using the internet for advertising, online business and virtual organisation activities.

About 178 sampled firms (farmers) in four regencies (Jember, Banyuwangi, Malang, Sidoarjo) were interviewed in 2006. The respondents were given their opportunity to respond to multiple options on the purpose for adopting ICT. Five options of ICT use were proposed: (i) ICT for communication among employees, (ii) ICT for communication between companies and distributors, (iii) ICT for marketing and sales, (iv) ICT for searching company's resources, and (v) ICT for other purposes.

Results of the analysis show that all samples in group 1 (100%) adopted the lowest level of ICT. Group 2, 3, and 4, respectively, adopted 75.3%; 44.9%; and 10.7%. This indicates the default automatic adoption level of which all businesses operate at the minimum. The ladder shows that the higher the level, the smaller the percentages of sampled firms. This means that as ICT technology becomes more sophisticated, fewer sampled firms opt to adopt the higher levels on the ICT ladder. Also, firms at the higher levels still use ICT technology from the lower levels. In other words, the existence of adopter advanced levels of ICT does not mean a reduction of use at the lower levels. Some businesses maintain their existing ICT adoption levels and are not interested in improvement by moving to the more sophisticated levels of ICT, due to considerations which will be investigated in this research.

The results also show that general purposes of using ICT at the very basic level of the ladder needs to be investigated in order to draw a picture of the benefit of adopting ICT.

Keywords: ICT adoption, agribusiness, Indonesia

1. INTRODUCTION

The issue of ICT adoption recently has become a priority to support Indonesian agribusiness development facing the globalization era. Through the Indonesian Ministry of Agriculture, e-agribusiness was introduced to the public in early 2000. Web portal and mobile phone messages were initiated by the Ministry to service agribusiness in accessing the most recent agricultural information. The information was freely accessible for farmers at any time. Some telecenters were also developed to support agribusiness located in rural areas. However, there was no funding support provided by the Indonesian Government for installing the internet for their individual businesses. Self-financing was encouraged to be the most feasible option to agribusiness. Therefore, the speed of adoption of ICT technology in agribusiness depends on both the external environment such as the government's role, competition and technology sophistication and the internal organization's capabilities.

Recently, technology sophistication such as internet technology is becoming very important in everyday activities including in agricultural activities. According to APO (2001), internet technology had now made it possible to search for and find the necessary information worldwide and on-demand very easily and quickly. Furthermore, the convenience of advertising or selling products worldwide using e-commerce facilities of the Internet technology had led to the rapid expansion of business activities including agribusiness. In the future the development of e-farmers would also be important for farmers to facilitate access agribusiness statistics and information through the ICT.

With regard to APO's statement, the future prosperity for East Java agribusiness is its ability to meet consumer preferences and challenge competitors using sophisticated ICT. Market information with advances in ICT is necessary to penetrate a global market (Gumbira-Said and Rachmayanti, 2001; MOA, 2005; Nainggolan, 2001). ICT can be highly beneficial for East Java On-farm Agribusiness (EJOFA) by developing an online marketing information system. The

Government of Indonesia (GOI) along with many Non Government Organization (NGOs), has also tried to embrace Small and Medium Size Enterprises (SMEs) including agribusiness in funding programs, conducting managerial training, and ensuring applicable technological adoption (APEC-ISTI, 2004). Therefore, the future directions of agricultural and rural development in East Java should aim at ensuring their growth with equity, towards decentralized, market-oriented, export-led agriculture on the basis of ICT. The private companies will be engaged to participate, especially in the use of capital intensive technology, in agricultural development to increase efficiency and product competitiveness. It is necessary to uncover the current trend of consumer preferences, which will determine what needs to be produced.

The context of agribusiness in East Java reflects agro-industry development in which the sector contributes significantly to the national economy. This sector has become the economic backbone of the province with its contribution to the province as the third rank in Gross Domestic Regional Product (GDRP) contribution, after trade and restaurant and mining sectors. Contradictorily, the agricultural industry is still lagging behind in using information technology which has resulted in rejected exports of agribusiness products such as fisheries (Antara, 2007). Therefore, it is curious to study the factors influencing agribusiness adopting and implementing ICT for competitive advantage. Some reports written by Sudaryanto Courvisanos, J. and Soekartawi (2007a,b).

With respect to agribusiness and ICT sophistication in East Java, it is clear that agribusiness needs to embrace ICT for business in order to improve its competitive advantage. Thus, the factors influencing ICT adoption in East Java on-farm agribusiness needs to be examined. Accordingly, the basic research question that should be answered: 'What are extent and purpose of adopting ICT for agribusiness development?'

2. METHODOLOGY

The sample size in this study is regressable with 178 samples. Details of this sampling can be seen in Sudaryanto (2009). Literature shows that adoption stage generally employs three factors namely Perceived Benefits (PB), Organisational Resources (RBV) and External environment (Cooper and Zmud (1990), Damanpour and Madison (2001) and Aguila-Obra and Padilla-Melendez (2006) and Aguila-Obra and Padilla-Melendez (2006). This can be seen in Figure 1.
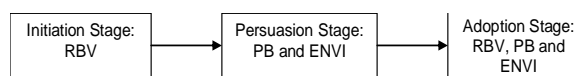

Figure 1. Initiation, Persuasion and Adoption Stage

Figure 1 presents an overview of the sequential adoption research framework. *Initiation stage* explores the organizational resources in a company needs in order to adopt ICT. These stages address

the issue of how RBV resources both physical (hardware) and human resources (software) required to successfully adopting ICT. The RBV factors are initiated in this stage in order to measure their capabilities facing the challenge of adoption ICT at any levels of ICT adoption ladder.

The *second stage* is the persasion stage which evaluates whether the firm's Perceived Benefits (PB) are influenced by External environment (ENVI) factors. The model aims to answer the research question on whether the External environment factors influence the Perceived Benefits in EJOFA.

The *third stage* is the adoption stage is the how RBV, PB, and ENVI determine the level of ICT adoption by employing all RBV factors (O), External environment (ENVI), Perceived Benefits (PB) based upon Technological Organizational and Environmental (TOE) model. This adoption stage addresses to answer the third research question on what are the factors influencing ICT adoption in EJOFA.

Binary step-down Logistic Regression was conducted on three characteristics: PB, RBV, and ENVI as independent variables, while computer adoption as the highest level of ICT adoption is the dependent variable.

The Logit model allows any types of data as independent variables with one or more variables are binary (dummy) (Hosmer and Lemeshow, 1989; Kmenta, 1971, p. 425). This study uses binomial Logit using enter method instead of stepwise method. Stepwise method works under trial and error procedure to find the best regression estimation. The variables are run all together at the first stage and then are deleted as some independent variables which contribute insignificantly to the model. However, stepwise method is not applied to test the theory which is normally stated in the hypotheses (Menard, 1995). Stepwise method is applied for exploratory research with no hypothesis testing. The method works under statistical parameters rather than theoretical based. The stepwise method is not used in this study in which hypotheses testing are investigated.

The following model is the Logit equation for the research. The Logistic regression model is as follows:

$$\ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 \chi labor + \beta_2 \chi sales + \beta_3 \chi age$$
$$+ \beta_4 \chi education + \beta_5 \chi literacy + \beta_6 \chi \exp erience$$
$$+ \beta_7 \chi \exp erience_2 + \beta_8 \chi reliability + \beta_9 \chi operat \cos t$$
$$+ \beta_{10} \chi serv \cos t + \beta_{11} \chi Govt \sup + \beta_{12} \chi Techsop$$
$$+ \beta_{13} \chi Edutrain + \beta_{14} \chi Compress + \varepsilon_i$$

Where: *ln* is natural logarithm, *p* is the probability of adopting computer; β_0 is constant value, β_i are parameters to be estimated; $y_i = \left(\frac{P}{1-P}\right)$ is dependent variables on ICT adoption that takes on a value of Yes=1 if the respondent adopt ICT, and No= 0 if not adopting ICT. The predictors are: (1)

RBV, (2) External Environment and (3) Perceived Benefits.

Details of this model and measurement variables may also be seen in Sudaryanto (2009)

3. RESULTS

There are two main observations reported in this paper, namely ICT adoption by samples, and factors affecting adoption of ICT in agribusiness. In this case it is reported an adoption and the use for internet only, while adoption for others ICT tools they can be seen in Sudaryanto (2009).

ICT adoption by samples is presented in Figure 2. Data in Figure 2 shows that that all samples in group 1 (100%) adopted the lowest level of ICT (conventional ICT). Group 2, 3, and 4, respectively, adopted 75.3% (computer); 44.9% (internet); and 10.7% (e-business).

Figure 2 also presents the ICT adoption ladder in EJOFA from the sample surveyed. The sample distribution reflects the highest level of ICT adoption by business with the lower level. This is the default automatic adoption level to which all businesses of the at least operate at minimum. The ladder shows the higher the levels the smaller the percentage. This means that as the ICT technology becomes for sophisticated, less firm opt to adopt the higher levels in the ICT ladder. Also firms at the higher level, still use ICT technology from the lower levels. In other words, existence adopter in advance level of ICT does not equal to the lower levels adopter. Some business maintains their existent ICT adoption levels and are not interested to improving the more sophistication ICT due to considerations which will be investigated in this research.

From Figure 1, it can explained that the higher the level, the smaller the percentages of sampled firms. This means that as ICT technology becomes more sophisticated, fewer sampled firms opt to adopt the higher levels on the ICT ladder. Also, firms at the higher levels still use ICT technology from the lower levels. In other words, the existence of adopter advanced levels of ICT does not mean a reduction of use at the lower levels.
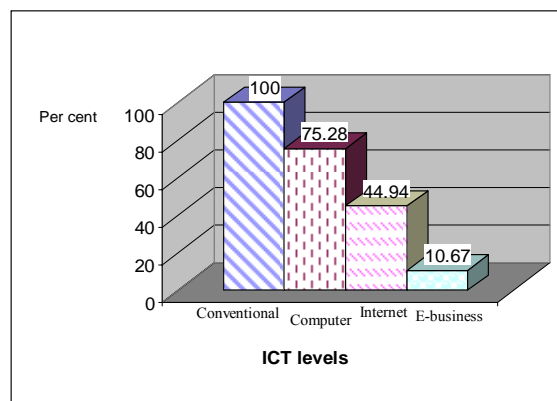

Figure 1. ICT Adoption Ladder in EJOFA

Factor affecting ICT-internet adoption is reported in the following section, i.e. applying six models used to test 15 hypotheses. Variables used in each model (which represented hypothesis) are the following:

Table 1. The Logit's Types of Variables and Measurements

Variables	Variable Number	Descriptions	Types of data
$y_i = \left(\dfrac{P}{1-P} \right)$ **(Dependent Variable/s)**		The level of adopting ICTs 1. Conventional 2. Computer 3. Internet, 4. E-business	Dichotomous; Yes=1, No= 0 if otherwise
A. RBV's Predictors:			
1. Physical resources			
• *Labor*	X_1	Number of labor in the firms	log10 of number of labor
2. Financial resources			
• *Sales*	X_2	log10 of gross sales volume	log10 of gross sales
4. Human resources (demographic characteristics)			
• *Age* ≥40	X_3	Manager's age more than 40	Dummy variable
• *Education TAFE or less*	X_4	Manager's education less than TAFE	Dummy variable
• *Literacy*	X_5	ICT literacy of managers'	Scale 1= very weak, 5 = very strong
• *Never used computer*	X_6		Dummy variable
• *Experience* ≥5 yrs	X_7	≥ 5 years	Dummy variable
B. Perceived Benefits Predictors			
• *Reliability*	X_8	Reliability of ICT	Composite variable
• *Operatcosts*	X_9	Reduces operating cost	Composite variable
• *Servcosts*	X_{10}	Reduces services cost	Composite variable
C. External environments			
• *Govt support*	X_{11}	Government regulations	Composite variable
• *Tech sophistication*	X_{12}	Technological capabilities	Composite variable
• *Degree educ. train*	X_{13}	Education and training	Composite variable
• *Com experiences*	X_{14}	Competitive pressure	Composite variable
• *Voc. training*	$X15$	Education and training	Composite variable
ε		Assumed to be a standard normal	Composite variable

Table 2. Summary of Hypotheses Testing of ICT-Internet Adoption

Hypothesis	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
H1- Firm size is related positively to ICT-Internet adoption in East Java agribusinesses	accepted at 99%	accepted at 99%	rejected	accepted at 90%	accepted at 90%	accepted at 95%
H2- Gross sales of the firm are related positively to ICT-Internet adoption in East Java agribusinesses	NA	rejected	rejected	rejected	Rejected	rejected
H3 - Firms in East Java agribusinesses with managers aged over 40 are more likely to be ICT-Internet adopters than other firms.		NA	accepted at 90%	accepted at 90%	accepted at 90%	accepted at 90%
H4- Firms in East Java agribusiness with managers who have a TAFE qualification are more likely to be ICT – Computer adopters than other firms.			accepted at 99%	accepted at 99%	accepted at 99%	accepted at 99%
H5- Firms in East Java agribusinesses with managers who have ICT literacy are more likely to be ICT-Internet adopters than other firms.			accepted at 99%	accepted at 99%	accepted at 99%	accepted at 95%
H6- Firms in East Java agribusinesses with managers who do not have computer experience are more likely to be ICT –internet adopters than other firms.			rejected	rejected	rejected	rejected
H7- Firms in East Java agribusiness with managers who have had less than five years computer experience are more likely to be ICT-Internet adopters than other firms.			rejected	rejected	rejected	rejected
H8- The more the perceived benefits of reliability gained from adopting ICT –I nternet, the more the positive contribution on the likelihood of adopting ICT-Internet in East Java agribusinesses.			rejected	rejected	rejected	rejected
H9- The more the perceived benefits of reduced operating costs gained from adopting ICT-Internet, the more the positive contribution on the likelihood of adopting ICT-internet in East Java agribusinesses.			NA	accepted at 95%	rejected	rejected
H10- The more the perceived benefits of reduced services costs gained from adopting ICT, the more the positive contribution on the likelihood of adopting ICT-Internet in East Java agribusinesses.				rejected	accepted at 95%	accepted at 99%
H11- Government support has a positive contribution on the likelihood of adopting ICT-Internet in East Java agribusinesses.				NA	rejected	rejected
H12- Technology sophistication has a positive contribution on the likelihood of adopting ICT-Internet in East Java agribusinesses.					accepted at 90%	accepted at 90%
H13- Education and training readiness has a positive contribution on the likelihood of adopting ICT - Internet in East Java agribusinesses.					rejected	rejected
H14- Competitive pressure has a positive contribution on the likelihood of adopting ICT –Internet in East Java agribusinesses.					rejected	rejected
H15- The existence of vocational agricultural universities nearby the firms is related positively to ICT-Internet adoption in East Java agribusinesses					NA	accepted at 95%

Applying Logit's model and using the above dependent variables resulted data analyses as presented in Table 2. From this table, it can be seen that each explanatory variable used in the model has different power in explaining the respected dependent variables. Model 6 is most powerful model followed by model 4.

Taking account of the vocational agricultural universities (VAU) variable in this Model 6 ensures that one of the external environment variable predictors increases the level of significance especially 'reduced services costs' which increases significance of the confidence intervals from 95 to 99 per cent levels with 1.641 odds value. The odds ratio of adopting ICT-Internet increased by 1.641 times caused by the increasing 'reduced services costs' as an impact of considering the existence of vocational agricultural universities near the firms. The VAU variable itself has a 95 per cent confidence intervals with a 0.357 odds value. This means that by including vocational agricultural universities in the external environment factors, the odds value of ICT-Internet adoption is increased by 0.357 times.

Model 1 and Model 2 accept firm size as a significant influencing factor. Model 3 accepts three

variables and rejects five others. Model 4 accepts five variables and rejects five variables while Model 5 accepts six variables and rejects eight variables. Model 6 has the best variables composition by which seven predictors on adopting ICT-Internet were accepted, but eight others were rejected. Some of them are consistent with their respective significance levels from previous models while others are not.

4. CONCLUSION AND SUGGESTION

The process of identifying ICT adoption drivers through the ladder resulted in different sets of suitable model compositions. The varieties of the compositions of variables as drivers became the focus of the models at each adoption level.

Regards to ICT adoption by samples, it is presented in Figure 2. Data in Figure 2 shows that that all samples in group 1 (100%) adopted the lowest level of ICT (conventional ICT). Group 2, 3, and 4, respectively, adopted 75.3% (computer); 44.9% (internet); and 10.7% (e-business). Figure 2 also presents the sample distribution reflecting the highest level of ICT adoption by business with the lower level. Figure 2 also shows the higher the levels the smaller the percentage. This means that as

the ICT technology becomes for sophisticated, less firm opt to adopt the higher levels in the ICT ladder. Also firms at the higher level, still use ICT technology from the lower levels. In other words, existence adopter in advance level of ICT does not equal to the lower levels adopter. Some business maintains their existent ICT adoption levels and are not interested to improving the more sophistication ICT due to considerations which will be investigated in this research.

The factor influencing at the ICT-Internet adoption level was influenced by the manager's education background of TAFE or less. ICT Literacy also influenced the adoption with expectation of reducing services costs on adopting ICT. Without measuring the impact of external environment factors, there seem to be no difference on the number of influencing factors. It means that external environment factors play direct crucial roles on ICT-Internet adoption in EJOFA without expecting the perceived benefits of adopting ICT.

Knowing that research in the role of ICT in agribusiness is less taken into account (rarely done) the similar research and initiative new research on ICT adoption in agribusiness shall be pushed through. This is because the issue of ICT adoption recently has become a priority to support Indonesian agribusiness development facing the globalization era. Through the Indonesian Ministry of agriculture, e-agribusiness was introduced to the public in early 2000. Web portal and mobile phone messages were initiated by the Ministry to service agribusiness in accessing the most recent agricultural information. The information was freely accessible for farmers at any time. Some telecentres were also developed to support agribusiness located in rural areas. However, there was no funding support provided by the Indonesian Government for installing the internet for their individual businesses. Self-financing was encouraged to be the most feasible option to agribusiness. Therefore, the speed of adoption of ICT technology in agribusiness depends on both the external environment such as the government's role, competition and technology sophistication and the internal organization's capabilities.

The main policy implication taken from this research may be written as follows:
1. The role of ICT in agribusiness and the importance of this in the economic autonomy of provinces like East Java. Thus the large government support for this development can lead to improve better economic development.
2. The ability of small firms to cross the digital divide is crucial for improving equality of opportunity in the knowledge economy era.

The authors recognize some limitations in conducting this research. The number of sample, data types, population coverage and the use of the statistical software are also part of the limitation in this study. The cross sectional data collected from relatively small number of sample created some missing data such as zero values in the cross tabs which harms logit analysis. Therefore it is suggested to use a larger the sample size with panel data would provide better statistical results. The sample coverage was only on-farm agribusiness in four regions in East Java. The wider the coverage and heterogeneity of the target population the better the results represented.

Regards to the future research it is suggested that such research that would be able to understand the variations of the drivers in this study e.g in specific field of agribusiness, within different size of businesses, in specific ICT tools and between adopters and non adopters is needed. Deeper exploratory investigation would provide confirmation or modification of the findings. The research framework developed in this study can be an important starting point for any research in other provinces in Indonesia or in any other developing countries.

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