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Transforming Smallholder Farmers Business towards Agribusiness: A Framework Using ICT

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ABSTRACT

This paper introduces a framework using ICT to transform smallholder farmers' traditional business towards agribusiness in Malaysia by extending the existing theoretical framework. The introduction of agribusiness to the farmers is not well understood and difficult to implement due to their limitations as smallholder farmers. The framework outlining ICT usage which was improved through identifying major factors affecting agribusiness transformation by using ICT such as environment (ENV), technology (TECH), farm work design (FWD), and information system elements (ISE). This paper focuses on testing relationships between ENV and TECH which acting as independent variables (IVs) towards agribusiness transformation using ICT as dependent variable (DV). The moderation effect of ISE and FWD acting as moderation variables (ModVs) which interacted with TECH towards agribusiness transformation using ICT were also being investigated in this paper by using slope analysis. This research used a quantitative approach to explore the nature of the phenomenon through the underpinned theory available in information systems theories such as technology-organisation-environment (TOE), technology acceptance model (TAM), diffusion of innovation (DOI), and task-technology fit (TTF). The method chosen in this research was

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questionnaire, which was distributed to more than 209 smallholder farmers in Taman Kekal Pengeluaran Makanan (TKPM) in Selangor. The statistical results provided the researcher the opportunity to outline the ICT usage framework to be used to transform smallholder farmers' traditional business towards technological intensive agribusiness. Overall, the findings outline the low level of information system elements and farm work design influencing the technological effect towards agribusiness transformation using ICT.

Keywords: Agribusiness, agriculture technology usage, ICT framework, smallholder farmers

INTRODUCTION

Farmers need to manage their agricultural business and productivity resources effectively by using computers and internet connectivity to stay competitive in the agricultural industry (Nuthall, 2004). There are many studies related to information and communications technology (ICT) usage conducted in agriculture involving large farm firms worldwide (Adams, 2007; Taragola & Van Lierde, 2010). However, in the Malaysian context, most of the farm operators, especially in the agro-food subsector, are considered small farmers; they are agricultural entrepreneurs who find it challenging to remain competitive in the agricultural market (Department of Agriculture, 2010a). In Malaysia, the use of ICT in managing farm business and activities is still unknown (Malaysian Communications and Multimedia Commission [MCMC], 2012) as almost 40% of fruit growers are over 50-years old (Performance Management and Delivery Unit, 2011). It seems that older farmers are not willing to use ICT in their agriculture activities. However, some scholars outlined that the age of farmers was not a factor for ICT usage in agriculture (Alvarez & Nuthall, 2006; Botsiou & Dagdilelis, 2013). Therefore, the investigation of ICT usage must look beyond farmers' behaviour and demographic profile.

The aim of introducing Agribusiness in Economic Transformation Programme (ETP) is to advance the agricultural industry to become more competitive and contribute highly to the country's gross national income (GNI). The transformation towards agribusiness is also related to the process of improving the scale of farms and yields that link to the supply chain system in agriculture (Performance Management and Delivery Unit, 2011). This highly demanding process requires farmers to improve their farm activities and daily operations in every element of their agriculture projects (Nuthall, 2011). Since all agriculture projects are unique, smallholder farmers face highly competitive challenges in improving their production so as to suit the supply chain providers from both the private and public sectors (Sen & Choudhary, 2011). Nevertheless, both sectors also need to work together and integrate these practices into their suitable business cases. This difficulty has affected ETP implementation in Malaysia.

Most failures in agriculture projects are due to poor management and planning from the beginning of the project and during its implementation (ERA Consumer, 2001). Agricultural sustainability, which relies significantly on good farm management, is therefore crucial. In Malaysia, most small- and medium-sized local farmers still depend on the traditional methods to manage their farms. Even though the ICT penetration amongst Malaysian has increased dramatically, the use of software and information systems for managing daily farm operations, especially in modern farming, is still low and remains at the beginning stage. The exact main reasons that Malaysian farmers are not using ICT in agriculture remain unknown and these will be explored in this research.

Some scholars have claimed that smallholder farmers are not part of the value chain and community (Vermeulen & Cotula, 2010). It was due to the term 'agribusiness' that is also known as the entity or agency element in the agricultural value chain focusing on the production, logistics, and business operation from the upstream to downstream of agricultural value chain. However, other scholars have stated that smallholder farmers are also part of the source and input suppliers in agriculture (Martin & Jagadish, 2006; Sen & Choudhary, 2011). Therefore, one useful suggestion is to isolate them from the value chain so they can be empowered to continuously support the agricultural value chain.

Despite numerous definitions of 'agribusiness' and its relation with the food and supply chain system, there is a need for critical and fast decision making by farmers in natural farming activities (Salin, 1998). Thus, consolidating all data, especially the farm activities, becomes important to support farmers' decision making. Prior to this, farmers may utilize the internet and recently developed devices such as tablets and smartphones to consolidate the data by using Farm Management Information System (FMIS) as an application to collaborate and interrelate with other information on the internet to facilitate more precise decision-making (Salami & Ahmadi, 2010). Therefore, the researcher focused on farm management, which is essential for all farmers, including smallholder farmers, to use FMIS as an ICT solution for transforming their traditional business towards agribusiness. By integrating the information system elements (ISE) in FMIS with the Information Systems Theory from the literature, the new ICT usage framework is introduced in this research.

Literature Review

Construction of the Framework and Hypothesis. The principles underlying the construction of this research framework rely on the literature review and theory underpinned in this study. This study outlines four major elements focusing on ICT usage from the technology and environment aspects, information system elements and farm work design, the tasks in farm and agriculture application.

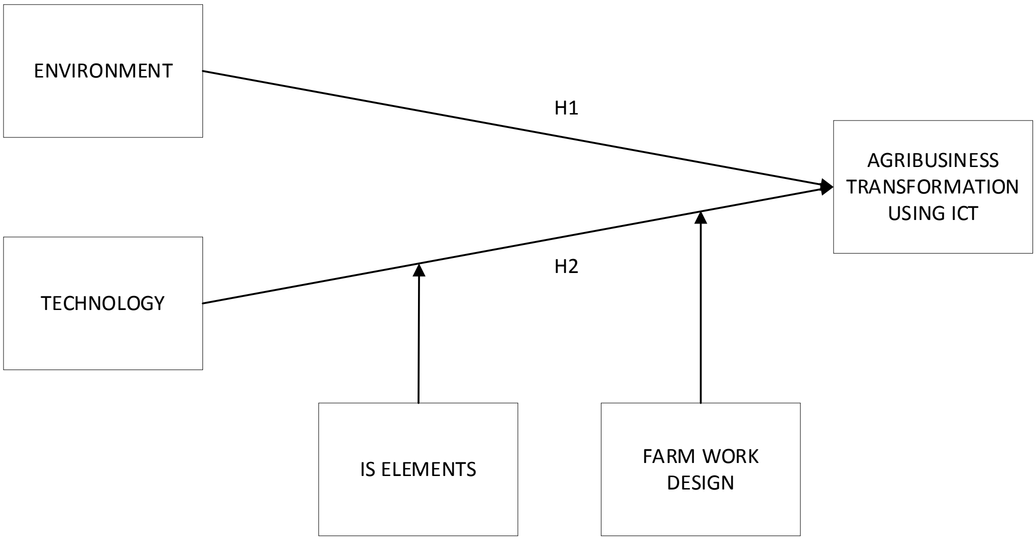


Figure 1. Proposed ICT framework in transforming smallholder farmers business towards agribusiness

This research framework was derived from the previous IS theories such Technology Acceptance Model (TAM), Technology-Organisation-Environment (TOE) and job design theories. It consists of four main independent variables which are considered as the factors influencing ICT usage by smallholder farmers in Malaysia. Technology and environment are the two main independent variables. Meanwhile, information system (IS) elements and farm work design are the moderating variables which interact with technology to affect ICT usage. The level of moderation is the degree of slope interaction effects of both moderating variables on the main technology variables in the research framework.

Technology and Environment Aspect. The technology and environment variables were derived from the technology-organisation-environment (TOE) framework introduced by Tornatzky and Fleischer (1990). A previous research supports the evidence that large organisations are more willing to adopt new technology compared to small organisations (Bertschek & Fryges, 2002). This is because the resources and capacities of a large organisation are much higher compared to those of a small organisation with less resources such as smallholder farmers (Vermeulen & Cotula, 2010). Nevertheless, some researchers have argued that farm size affects ICT adoption and usage (Smith et al., 2004). The researcher believes that this will not affect the ICT usage among smallholder farmers in Malaysia. Therefore, the organisational factor in TOE framework has been excluded, while the technology and environment factors are included in this study.

The TOE framework is well-defined in Tornatzky and Fleischer's book, *The Processes of Technological Innovation* (Tornatzky & Fleischer, 1990). The book describes the process of innovation with a focus on the development of innovations by engineers and entrepreneurs regarding the usage and implementation of those innovations by users within the context of technological, organisational and environmental setting. The TOE framework represents how the organisational context influences the usage and implementation of innovations. However, the TOE framework provides a "generic" theory, in which the three major factors of technology, organisation, and environment are placed (Zhu & Kraemer, 2005). Therefore, many scholars integrate the TOE framework with others related to the technology usage theories such as technology acceptance model (TAM) and diffusion of innovation (DOI) (Awa et al., 2010; Thong, 1999; Wu & Liu, 2015).

The technology context refers to technology that is available for and currently used by the firms in the market (Tornatzky & Fleischer, 1990). Therefore, the researcher measures the technology through the context of ICT, as well as agricultural technology which is based on ICT that is currently used by smallholder farmers. For instance, intense competition stimulates usage of innovation (Mansfield, 1977). In addition, the dominant subject within the value chain can influence other value chain partners to innovate. This TOE framework context can be indicated as one of the main criteria to measure the factors affecting the proposed framework and hypotheses.

Meanwhile, the environment factor includes the smallholder farmers' environmental or external factors that may influence ICT usage among them. It includes the environment of Malaysian agriculture such as social influences, competitive pressures, and other factors for smallholder farmers' business. The environment factor also identifies the external factors of organisations in the TOE framework (Tornatzky & Fleischer, 1990). In contrast, organisations focus more on internal factors such as firm size, management structure, and so on.

Farm Work Design is a Task Characteristic of Agricultural Application. The task characteristic in agricultural application underpins the work and job design model and it should be distinguished from the task-technology fit (TTF) model. In the TTF model, the task characteristic is non voluntary, whereas for the farm work design, it has to be voluntary (Goodhue & Thompson, 1995; Ilgen & Hollenbeck, 2003; Morgeson & Humphrey, 2008). The TTF model focuses more on task fit while using technology, whereas this research focuses on the task or job characteristic in the agricultural application, which is best known as job or work design in agriculture. The TTF framework introduces direct effect towards technology usage, whereas the researcher would like to further investigate whether the interaction with technology of smallholder farmers' job design influences ICT usage.

Much crucial research has been carried out into work design especially in terms of psychology and organisations, specifically on the behavioural effects of work design. Work design means how the contents of the work including tasks, activities, relationships, and responsibilities of each individual assist in the achievement of every organisational and business goal. Work design influences individuals' attitudes, behaviours, pro-social differences, motivations, cognition, satisfaction, and performance that will lead to better organisational achievements (Grant, 2007; Morgeson & Humphrey, 2008; Sutherland & Cooper, 1992). For many years, research on work design has become more comprehensive and expanded into cross-disciplinary research.

Information System Element. Information system element (ISE) is a service that helps people to organise and analyse data to achieve their objective. ISE is widely used in most organisations nowadays as part of the ICT deployment to improve business processes and enhance organisation's performance (Laudon & Laudon, 2007). Such processes are usually represented in the hierarchy of the organisation and reflected by the people working in the organisation. Several levels incorporate ISE such as transaction processing systems, management information systems, decision support systems, and finally, at the top of the hierarchy, executive information systems.

As ISE is most representative of the organisation, it also directly interacts with the people who are represented as users of the system. The elements or components of ISE interact with the users to ensure that the functionality of ISE is feasible. The elements or components of ISE are usually involved with the contents and presentation, which lead to more details of the system's functions and available features (Bakar et al., 2010; Sørensen et al., 2011). The researcher has outlined ISE in previous research articles used in this research (Danuri et al., 2016, 2017).

Moderation and Interaction Effects. A few researchers have found that moderation or interaction effects play a major role in ICT usage (Chen et al., 2006; Johnson, 2012; Wu & Liu, 2015). The efficacy of online co-operative learning systems outlined group task to moderate the information characteristics that affect the satisfaction and performance of technology usage (Chen et al., 2006). Meanwhile, Wu and Liu (2015) outlined that the way any person processes information would combine with technology factors that influenced ICT usage. In the agricultural context, although technology can assist farmers to improve ICT usage, it raises the following key questions: what makes farmers to be willing or unwilling to use ICT? What if the technology factor is moderated by work and others? The researcher argues that the TTF mediation variable, as introduced by Goodhue and Thompson (1995), shows a strong direct effect on technology usage. The interaction effects between technology, IS elements and farm work design have been examined by the researcher in this study.

There are many previous literature researches that apply IS theories into the study of agriculture. However, some of the research do not improve on the theories itself, as they do not contribute to a better body of knowledge (Aleke et al., 2011; Samah et al., 2011). They just apply existing theory to their study such TAM, including the introduction of external variables, and focus on descriptive analysis. Only a few scholars have introduced new knowledge to TAM. Some of them introduced extra and external elements in order to extend the theory, such as perceived resources, and others (Mathieson et al., 2001; Musa et al., 2005; Pierpaoli et al., 2013). This has improved the body of knowledge of the IS theories, however, in the context of agriculture, the application still needs a lot enhancement especially with the interaction with the farm works design that specifically in the context of the study.

This is the first time the researchers takes into consideration the moderating role of IS elements and farm work design as the moderating variables which interact with the technological effects on ICT usage. This is called the 3-way interaction, which involves more complex analysis compared to the 2-way interactions analysis (Francoeur, 2011; Reinholt et al., 2011). Further investigation of significant interaction terms varies substantially and is sometimes error prone. Therefore, it is important to understand the nature of 3-way interaction between the low and high levels of moderation. The researcher used the simple slope analysis introduced by Jeremy Dawson to further interpret the 3-way interaction in this study (Dawson, 2014).

METHODOLOGY

The research method adopted in this study allowed deductive research theory-testing before presenting the findings, which might extend the underpinning existing theory and strengthen the new ICT usage framework in the context of agriculture in Malaysia. In this study, the researchers selected the quantitative approach using questionnaires which had been distributed to 209 farmers in Taman Kekal Pengeluaran Makanan (TKPM) in Selangor as stated in Table 1. The questionnaire content was adapted from a previous research to sustain the reliability and validity of the instrument (Davis, 1989; Gelb et al., 2008; Morgeson & Humphrey, 2006; Sorensen et al., 2010). Furthermore, the questionnaire was verified through two stages of face validation by several subject matter experts (SME) before distributing it to the target population. The first stage involved several experienced researchers at the Department of System Management, Faculty of Information Management, Universiti Technology MARA while the second stage involved selected SMEs from the Selangor Department of Agriculture (DOA). Amendment and rearrangement of the questionnaire were done according to the feedback received from them.

Other than that, the researcher also ensured validation during a pilot test by using exploratory factor analysis (EFA) for construct validation. EFA is done to examine the factor loadings for each item before any action can be taken such as rearranging and removing the items. During the pilot test, copies of the questionnaire were distributed to 100 potential respondents selected from the target population. A pilot test gives feedback on the clarity of the questions and the reliability of the instrument. It is an important step which must be conducted to ensure that the instrument is comprehensive before distributing it to the actual population.

The target population for the generalisation of this research area was the smallholder farmers. They represent the agriculture entrepreneurs, many of whom were individual farmers. The double sampling method was chosen because all Taman Kekal Pengeluaran Makanan (TKPM) in Selangor were selected as the sample for this research, in which the nature of research in the study population that served as the setup area might have excluded external factors that could potentially influence the research (Sekaran, 2003). Completing the actual survey distribution took about three months. There were total of 67 questions in the questionnaire excluding those in the demographic section. Each respondent was asked to answer all the

Table 1
List of Taman Kekal Pengeluaran Makanan in Selangor 2011

No	TKPM	Size developed (Ha)	Number of participants	Major crops
1	Sg. Blankan, Sepang, Selangor	400.00	151	Cassava, sweet potatoes, vegetables
2	Ulu Chuchuh, Sepang, Selangor	100.00	21	Sweet potatoes, vegetables
3	Bestari Jaya, Kuala Selangor, Selangor	57.00	22	Vegetables, melons, livestock
4	Bkt Changgang, Kuala Langat, Selangor	36.00	14	Orchids, vegetables, livestock
5	Semenyih, Ulu Langat, Selangor	36.00	8	Cattle, starfruit, guava
6	Sg. Kelambu, Kuala Langat, Selangor	80.00	18	Pineapple, cassava
7	Batang Si, Ulu Langat, Selangor	65.09	12	Papaya, star fruit
8	Serdang, Selangor*	5.00	10	Melon
9	Kundang, Kuala Langat, Selangor	120.00	41	Cassava, sweet potatoes,
10	Hulu Yam, Hulu Selangor, Selangor	116.00	34	Vegetables
11	Siswazah, Serdang, Selangor	3.00		Melon
Total Number of TKPM Selangor		1,018.09	331	

questions, which took approximately 10 to 15 minutes. From a total of 331 respondents, only 209 responded to the questionnaire. Thus, the response rate was around 63.2% of the total respondents.

Construction of the Hypotheses

We live in an era where ICT acts as an enabler in many other sectors. In general, living conditions have improved. Many people are using ICT in their lives, and it has been shown that ICT improves their livelihoods (Duncombe, 2006; Richardson, 2005; Singh et al., 2008). The environment has been shaped by many improvements in technology. However, there is still a lack of ICT usage even though the environment setting has improved. This becomes a major concern after all the pledged initiatives, especially by the government, to improve the level of ICT usage. Thus, the researcher investigated this matter further. The researcher decided to examine this factor within the best environment setting in the country. Therefore, the study was conducted in the state of Selangor, which has the highest ICT penetration in the country, as explained in the sampling selection. Therefore, the first generated hypothesis is as follows:

H_1: The environment factor has a positive effect on the use of ICT.

A growing body of research demonstrates that technology factors predict the level of ICT usage in positive ways. The technologies grow rapidly and represent significant and sudden growth of ICT (Tan & Eze, 2008). If the factor of technology is low, the level of ICT usage will probably drop in tandem. This is a common result in many studies. In the new knowledge era, however, the interaction between technology and other factors is considered important to explore the nature of understanding of ICT usage especially with other domains or principles of study.

The IS element is of great empirical importance in the ICT industry. It consists of the elements contained in the available system or software. Most of the elements are written in the products' specification and form part of the competitive advantage (Crinnion, 1992; Ghadge et al., 2010; Wilson, 2001). As a result, the IS element becomes one of the common factors for consumers' adoption and acceptance of the system. However, even if farmers are adopting ICT, they may not be aware of the IS elements (Ali & Kumar, 2011; Sorensen et al., 2010; Uphoff, 2012). Some complex system such decision support systems (DSSs) have been introduced to farmers to improve farm management efficiency and support decision making in farming activities (Kuhlmann & Brodersen, 2001). Nevertheless, since the systems are complex and sophisticated, farmers do not intend to use them. Therefore, the interaction of this element in the system with technology becomes an important factor for ICT usage in the context of ICT proficiency.

In this context, the researchers aimed to investigate further the effect of technology on ICT usage while interacting with this complex farm work design and IS elements. Both interactions were inspected together, and thus, the researcher postulated another hypothesis, as follows:

H_2: The effect of Technology on the use of ICT is highest when both Information System Elements and Farm Work Design are low.

Sampling Technique

The double sampling method was chosen, as all Taman Kekal Pengeluaran Makanan (TKPM) in Selangor are selected as the sample for this research whereby the nature of research exist in the study population as the setup area may avoid external factors that may influence the research (Sekaran, 2003). In 2009, Selangor, one of the earliest developed states in Malaysia, had the highest percentage of households with access to personal computer and ranked fourth highest for broadband penetration (Malaysian Communications and Multimedia Commission (MCMC), 2012). In addition, in 2010, Selangor had the highest agro-food sub-sector yield production with 11 areas of TKPMs and 331 participants in the cultivation program (Department of Agriculture, 2010b). Most of these farmers are categories as smallholder farmers which means the TKPMs area in Selangor was a suitable sampling area for this research.

Data Analysis

The total responds of questionnaire distributed are 207 (63%) and the data were keyed in and analysed using the statistical software. The researchers went through pre-processing data such identifying missing data, normal distribution and outliers. From the normality test conducted, there were two variables (Environment and ICT Usage) shows the result of the Shapiro-Wilk (ρ >0.05) test. The researchers had to conduct Skewness and Kurtosis test to determine the z score within the range ±2.0. As a result, all variables were finally determined as normal distributed. Subsequently, further analyses such as frequency analysis, exploratory factor analysis, confirmatory factor analysis, reliability analysis, correlation analysis, regression analysis and slopes analysis were performed.

RESULTS AND DISCUSSION

The Cronbach's alpha value of between 0.6 and 1.0 may be considered as providing a reasonable level of consistency in social science research (George & Mallery, 2003). However, some scholars suggest a higher value, such as more than 0.7, as a suitable coefficient alpha (Cortina, 1993). Nonetheless, it depends on the type and nature of the research. The items in the questionnaire were tested with factor analysis for item reduction and internal consistency using Cronbach's alpha reliability test. The factor analysis focuses on testing with both Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) to examine the factor loading for each of the items.

Table 2

Results from factor analysis and reliability

No	Variable	Type	KMO & Bartlett's Test		EFA Component	CFA Fixed Component	Action taken from existing item (s)	New sub-scales/items	Reliability Test (Cronbach's Alpha)
			Sampling Adequate	Sig.					
1	Agribusiness Transformation using ICT	Dependent	0.883	0.000	2	3	Drop questions no 79	3/ 11	0.868
2	Farm Work Design	Independent	0.883	0.000	4	4	No action taken	4/ 16	0.896
3	Technology	Independent (Moderation)	0.889	0.000	4	4	Drop question no 42	4/ 15	0.889
4	Environment	Independent (Moderation)	0.732	0.000	5	5	Drop questions no 55 & 66	5/ 16	0.720
5	IS Elements	Independent	0.796	0.000	2	2	No action taken	2/ 9	0.855

Table 2 illustrates that all the variables show Kaiser-Meyer-Olkin (KMO) results of more than 0.6 and a Sig. value < 0.5. However, the researcher had to drop some items, such as questions 20 (INNO2), 42 (PU3), 55, 66 and 79 during the factor analysis due to the factor loading of those items. Thus, the total for the new sub-variables or sub-scales was reduced to 18 and the total number of items tested was 67 for all the variables. The Cronbach's alpha reliability test was more than 0.7, which was acceptable.

Respondents' Profiles

Table 3 shows that most of the smallholder farmers (n=209) in the agro-food industry are males, with the majority of 185 male farmers (88.5%) compared to only 24 female farmers. Most of the smallholder farmers aged over 50 years (134 farmers or 64.1% of the total number of respondents) at the time of this study. This meant only 35.9% of the smallholder farmers aged below 50 years old. Meanwhile, in terms of race, the highest number of farmers are Malay (191 farmers or 91.4% of the total number of smallholder farmers in Selangor). There was only 1 Indian farmer and the remainders were Chinese (17 farmers or 8.1% of the total number of respondents). Most of the smallholder farmers are married (204 farmers, accounting for 97.6% of the total number of respondents), while most smallholder farmers had school-level academic qualifications (187 farmers, or 89.4%, with primary and secondary schools' qualifications). This meant only 22 farmers (10.6%) had higher education with a Diploma certificate as their minimum qualification. Finally, in term of income, 151 (72.2%) smallholder farmers earned more than RM3000, followed by 54 farmers (25.8%) had an income between RM1000

Table 3

Respondents' profiles and background

Background	Respondent	Frequency	Percentage
Gender	Male	**185**	**88.5**
	Female	24	11.5
Age	20-29 years old	3	1.4
	30-39 years old	23	11.0
	40-49 years old	49	23.4
	More than 50 years old	**134**	**64.1**
Race	Malay	**191**	**91.4**
	Chinese	17	8.1
	Indian	1	0.5

Table 3 *(Continued)*

Background	Respondent	Frequency	Percentage
Marital Status	Single	5	2.4
	Married	**204**	**97.6**
Academic Qualification	Primary School	77	36.8
	Secondary School	**110**	**52.6**
	Diploma	10	4.8
	Bachelor Degree	10	4.8
	Master Degree or Doctorate (PHD, etc.)	2	1.0
Income	Less than RM1,000	4	1.9
	RM1,001-3,000	54	25.8
	RM3,001-6,000	**97**	**46.4**
	RM6,001-10,000	50	23.9
	More than RM10,000	4	1.9

and RM3000, and only 4 farmers (1.9%) had an income of less than RM1000. In conclusion, the objective of TKPM to produce smallholder farmers with an income of more than RM3000 is considered a success, with more than 70% success rate.

Correlation Analysis

The correlation analysis needs to be conducted as pre-analysing the regression analysis as stated in Table 4. The result must show a significant relationship so that the variable can be included in the regression model as stated in Table 5. The researchers conducted a bivariate correlation after the value of variables had been centred.

There was a non-significant indicator of the relationship between farm work design and IS elements with $r = -0.066$, $n = 208$, $\rho > 0.05$. However, the researcher was not interested in investigating this relationship. Meanwhile, the results show some correlation results with $r > 0.8$, which probably has multicollinearity issue. Therefore, the researcher conducted Pearson correlation for all the variables again by using the centre value of each variables to avoid multicollinearity issue (Field, 2009).

Most modern scholars have said that correlation result does not provide any strong evidence to test a hypothesis as it shows only the relationship between the variables and does not carry any weight in a regression analysis especially for the moderation and mediation types of variables (Cohen, 1988; Dawson & Richter, 2006; Hayes, 2013). Therefore, the researcher extended the inferential analysis to regression and slope analysis.

Regression Analysis

The multiple linear regressions for all the independent variables, including the moderating variables, had correlation and

Table 4

Results for the Pearson Correlations between all centred variables with ICT usage

	Variables	1	2	3	4	5	6	7	8	9
1	ICT Usage	1								
2	Farm Work Design	0.181**	1							
3	Environment	0.423**	0.185**	1						
4	IS Elements	0.538**	-0.066	0.317**	1					
5	Technology	0.599**	0.143*	0.430**	0.535**	1				
6	Farm Work Design x Technology	0.069	0.134	-0.114	-0.151*	-0.007	1			
7	IS Elements x Technology	-0.216**	-0.128	-0.265**	0.007	-0.078	-0.147*	1		
8	IS Elements x Farm Work Design	0.079	0.112	-0.023	-0.194**	-0.177*	0.467**	0.027	1	
9	Farm Work Design x IS Elements x Technology	0.219**	0.307**	-0.008	-0.001	-0.089	0.340**	-0.326**	0.333**	1

Note: *$p < 0.05$. **$p < 0.01$

Table 5

Results of multiple linear regression analysis–dependent variable ICT USAGE and variables in the equation

Multiple R	0.733
R^2 (Pearson)	0.537
Adjusted R^2	0.518
S.E.	0.502
F=28.673, significance of F=0.0000	

Table 5 *(Continued)*

Variables	**Unstandardised Coefficients**		**Standardised Coefficients**	***T***	**Sig *T***
	B	**S.E. *B***	**Beta**		
Farm Work Design	0.044	0.056	0.042	0.781	0.436
Environmental	0.189	0.095	0.116	1.991	0.048
Information System Elements	0.303	0.061	0.303	4.991	0.000
Technology	0.459	0.070	0.413	6.518	0.000
Farm Work Design x Technology	-0.037	0.085	-0.026	-0.440	0.661
IS Elements x Technology	-0.130	0.064	-0.113	-2.048	0.042
IS Elements x Farm Work Design	0.258	0.089	0.171	2.903	0.004
Farm Work Design x IS Elements x Technology	0.224	0.084	0.159	2.674	0.008
(constant)	4.320	0.039		109.991	0.000

Note: *B*, partial regression coefficients; S.E. *B*, estimated S.E. of the partial regression coefficients; *T*, Student's t-distribution with N−2 degrees of freedom; Sig *T*, observed significance of Student's t.

contribution of (53.7%) at ($\rho < 0.01$) for the ICT usage among smallholder farmers in Malaysia. Using the enter method, it was found that environment and technology, which were moderated by farm work design and IS elements, explained a significant amount of the variance in the ICT usage by smallholder farmers in Malaysia ($F(8, 198)=28.673$, $\rho < 0.01$, $R^2=0.54$, $R^2_{Adjusted}=0.52$).

From Table 5, the analysis shows that farm work design did not significantly predict ICT usage (B=0.42, t=0.78, $\rho > 0.05$). The interaction between technology and farm work design also did not significantly predict ICT usage (B=-0.03, t=-0.44, $\rho > 0.05$). However, the researchers were not concerned with both these results. Instead, the researchers were more interested with the results obtained for the interaction between farm work designs and IS elements that reveals the effects of technology on ICT usage.

The most dominant independent variable for ICT usage was the technology factor (B=0.41, t=6.52, $\rho < 0.01$). The second dominant independent variable for ICT usage was the environment factor (B=0.12, t=1.99, $\rho < 0.05$). Meanwhile, for the moderation variables, the dominant moderating variable for ICT usage was the IS elements factor (B=-0.11, t=-2.05, $\rho < 0.05$). The farm work design reported earlier was not significant. Finally, both the moderation variables, farm work design and IS elements, that revealed the effects of the technology on ICT usage are significant with B=0.16, t=2.67, $\rho = 0.08$ ($\rho < 0.05$).

As shown in Table 5 above, the researchers were able to reject the Null Hypothesis and accept the Alternative Hypothesis, "H_1: The Environment factor has a positive effect on ICT usage". However, the rest of the results cannot further explain both the moderation effects (farm work design and IS elements) of technology on ICT usage. Therefore, the researchers conducted a simple slope analysis, which was introduced by Jeremy Dawson (2006, 2014), to further interpret multiple regression result and test the alternative hypothesis, "H_2: The effect of technology on ICT usage is highest when both information system elements and farm work design are low".

Model Comparison

Before the researchers could interpret the interaction effects with the simple slopes analysis further, he conducted model comparison so as to compare the multiple models that might exist in this study. Thus, the researchers conducted the coefficient of multiple correlation comparison between direct effect and multiple regression model for all the variables in the proposed conceptual framework. The result of R, coefficient of multiple correlation, takes the value between 0 and 1, whereby the higher value or near to 1 is the better prediction and higher correlation coefficient between the variables in this study. In order to confirm that the model fit is the best model, the results shown in Table 6 indicate that the 3-way interaction effect used in this

Table 6

Comparison of the coefficient of multiple correlation model

R	R Square	Dependent	Independent	Moderation/ Interaction	Description
0.628	0.394	ICT usage	Environment	-	Direct effects model
			Technology		
0.676	0.457	ICT usage	Environment	-	Direct effects model
			Technology		
			IS elements		
			Farm work design		
0.692	0.479	ICT usage	Environment		2-way interaction effects
			Technology	IS elements	
			Farm work design		
0.687	0.472	ICT usage	Environment		2-way interaction effects
			Technology	Farm work design	
			IS elements		
0.733	0.537	ICT usage	Environment		3-way interaction effects used in this study
			Technology	IS elements	
				Farm work design	

study is the better model. The interaction between IS element and farm work design with technology gave the higher value of R. Therefore, there is no doubt that the chosen type of 3-way interaction effects is the best suit for this study.

Simple Slopes Analysis

Slope analysis is widely used by many scholars for analysing moderating variables and interactions between independent variables and dependent variable (Aiken & West, 1991; Dawson, 2014; Dawson & Richter, 2006). However, several steps and procedures using multiple regressions need to be carried out before conducting a slopes analysis. All the data need to be centred so that the variables are standardised while the standard deviation has to be near to 1. In order to interpret the effects of interaction in this research, the researcher used the slopes analysis to test the interactions because the interpretation of coefficients can be slightly simpler.

Below are the results derived from the coefficient analysis for all the centred independent and moderation variables towards the dependent variable.

Table 7 shows the coefficient results for all the variables which include all the independent variables, all three pairs of two-way interaction terms, and the three-way interaction term. The values could then be inserted into the slope test formula Excel file provided by Dawson (2014) in his slopes website and the result as stated in Table 8.

This implies that the slope should be the most positive when ISE and FWD were both low, that is, slope (4) on the plot. To test the hypothesis, the researcher compared slope (4) with three other slopes, i.e. looking at three separate lines in the slope difference

Table 7
Coefficient analysis result for all centred variables

	Model	A	B	C	D	B*C	B*D	C*D	B*C*D
Covariances	A	0.009	-0.002	-0.001	-0.001	0.002	0.002	-0.002	0.001
	B	-0.002	0.005	-0.002	-0.001	5.843E-5	-0.001	0.001	0.001
	C	-0.001	-0.002	0.004	0.001	0.000	0.001	0.001	-0.001
	D	-0.001	-0.001	0.001	0.003	0.000	-7.669E-5	6.970E-5	-0.001
	B*C	0.002	5.843E-5	0.000	0.000	0.004	0.001	-0.001	0.002
	B*D	0.002	-0.001	0.001	-7.669E-5	0.001	0.007	-0.003	-0.001
	C*D	-0.002	0.001	0.001	6.970E-5	-0.001	-0.003	0.008	-0.002
	B*C*D	0.001	0.001	-0.001	-0.001	0.002	-0.001	-0.002	0.007

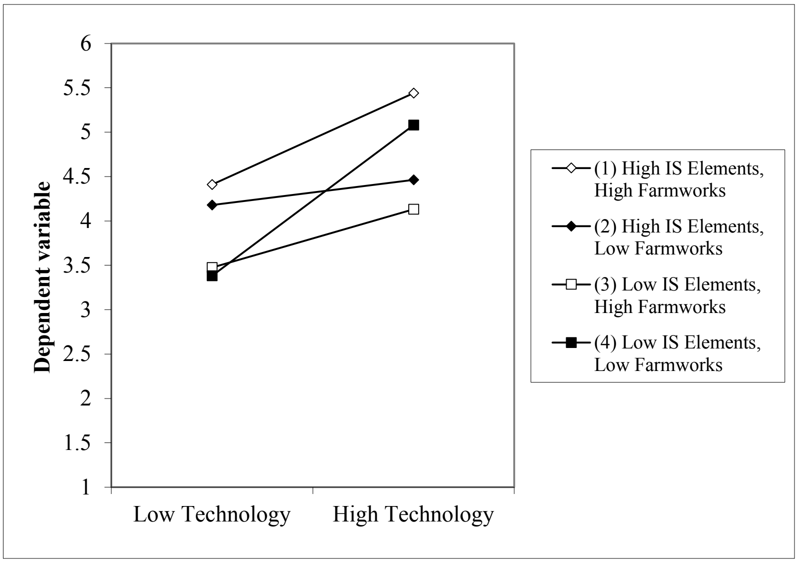
Note: Dependent Variable: E=ICT Usage
Where,
A = Environment
B = Technology
C = Information System Elements
D = Farm work design
E = ICT Usage

test table: (1) and (4); (2) and (4); and (3) and (4). The researchers found that they were all significant except for slopes (1) and (4), and therefore [as (4) is the most positive slope], the alternative hypothesis H_2 was supported and the null hypotheses was rejected.

Both ISE and FWD had a high line in the plot (1); which suggests that when ISE and FWD are high, ICT usage is always high. However, because it is always high, there is no effect of TECH on ICT usage, which is why the p-value is not significant (the two variables are unrelated under these conditions). This may be a useful and important finding in its own right; however, because the slope of the line is not fairly flat, it is related to the effect of TECH. The entire test took the environment factor as another independent variable, which is always constant.

Table 8

Slope 3-way interaction analysis results



Slope Difference Tests:

Pair of slopes	t-value for slope difference	p-value for slope difference
(1) and (2)	1.707	0.089
(1) and (3)	0.768	0.444
(1) and (4)	-1.465	0.145
(2) and (3)	-0.980	0.328
(2) and (4)	-4.231	0.000
(3) and (4)	-2.063	0.040

CONCLUSION

Many studies carried out in the field of information system have proposed models on ICT usage and acceptance (Davis, 1989; Tornatzky & Fleischer, 1990; Venkatesh et al., 2003). However, most of these frameworks and models were constructed according to their respective environment settings and surroundings. Since Malaysia is a developing country and the usage of internet among Malaysian farmers is quite recent compared to developed countries, previous ICT usage models may not suit the Malaysian context. Therefore, there is a need to develop a specific model that can be used as a guideline for Malaysian IS practitioners to solve the issue of how to encourage ICT usage among smallholder farmers in Malaysia. This could lead to better IS implementation in the Malaysian context.

This study proposes a moderation/ interaction process model of framework. This study adds to the literature by responding to the recent ICT usage in agriculture where there is a call of new research to propose a theoretical framework to improve the body of knowledge (Kang et al., 2015). The moderation effects in the underpinned theory can provide an extended understanding which enhances the existing TAM and TOE framework underpinning this study.

In the current study, the researchers constructed a new ICT usage framework which specifically caters for smallholder farmers in Malaysia. This framework was constructed through an empirical study that involved survey. The framework outlining ICT usage will be improved through identification of major factors affecting agribusiness transformation such as environment, technology, farm work design, and IS elements by using ICT.

In conclusion, based on the result of the analysis, the researchers have identified the variables that affect the use of ICT in order to transform the smallholder farmers' traditional business to agribusiness. The technology factor was identified as the dominant factor that influences ICT usage among smallholder farmers. From all the analyses carried out, it is clear that the technology factor significantly influences ICT usage while both IS elements and farm work design have only low levels of influence.

To further elaborate on this, for the smallholder farmers to adopt the IS elements (including the specifications of the system), such elements should be simple and not too high end. The farm work design also needs to be simplified and not too complicated so that smallholder farmers may use ICT in their agricultural application. Hence, the interaction between both low conditions IS elements and farm work design with technology will significantly improve ICT usage among smallholder farmers in Malaysia.

From the findings, the Department of Agriculture (DOA) should be aware that agribusiness transformation using ICT depends on the low conditions IS elements and farm work design. In order to improve the ICT usage, the DOA may introduced alternative method to reduce the farm works and activities in the farm such more automation and mechanization in agriculture activities. The low IS elements means that DOA should introduced simple and easy to use application system by the smallholder farmers. The application system should reduce the IS elements in the application system to ensure the smallholder farmers improved the ICT usage. The DOA officer may utilise the used of application system by the smallholder farmers and extend to management information system (MIS), decision support system (DSS), and other application systems for better management of all TKPMs. Therefore, the findings not only benefit the smallholder farmers, but also to other stakeholders such as DOA officers, researchers, and others.

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