The Application System Interaction Effect towards Technology on ICT Adoption

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Abstract. The Information and Communication Technology (ICT) should not extend only to the way of people communicate, but it should give impact to the way of people work and live. In the context of agriculture, ICT play a major role in reducing poverty and improving livelihood. There is realization that ICT should be integrated effectively in agriculture development as facilitating tools and applications to give its impact to the lives of farmers. The introduction of ICT to farmers should not limit to the general overview of technology adoption. It should extend towards the introduction of application system that suit to the nature of agriculture works as moderator due to many theories are more concerned with whether the effect of an independent variable on a dependent variable depends on another in the interaction effect study. This article intended to introduce the ICT adoption framework that used technology as main construct that interact with the moderator variable named as IS elements in application system that was introduced to the 209 respondents. The interaction effect was examined using coefficient of multiple correlations and multiple regression analysis in comparison with the direct effect model for all major constructs. The researcher also conducted the simple slopes analysis to examine further the level of interaction effect as additional finding. From the slopes analysis, the result shows that the technology has no effect on ICT adoption for low and high IS elements of application system.

Keywords: Interaction effect, application system, ICT adoption.

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INTRODUCTION

Farmers need to manage their agricultural business and productivity resources effectively by using ICT to stay competitive in the agricultural industry by using computers and internet connectivity (Nuthall, 2004). In order to complete use of ICT as solution, suitable application systems need to be introduced to the farmers. The application systems contain several information system elements (IS elements) that form a complete system.

The introduction of ICT to farmers should not limit to the general overview of technology adoption. It should extend towards the introduction of application system that suit to the nature of agriculture works (Sørensen et al., 2010; Steffe, 1997). In context of ICT adoption, the application system should not have direct effect to the adoption due to the system requirement elicitation. Therefore, this study was focused on the interaction effect of application system towards the technology on ICT adoption.

LITERATURE REVIEW

Malaysian farmers need to shift to new agricultural practices and paradigms in order to confront the dynamic agricultural and environmental challenge within farm management practices and systems. It is important to ensure a sustainable agricultural food supply, while guaranteeing safety and competitive in the agricultural industry and increasing farmers' income. The use and adoption of ICT may improve the way farmers work in agriculture industry.

Many scholars have conducted research into ICT adoption involving many different aspects and different domains (Aleke et al., 2011; Ashrafi & Murtaza, 2008; Busagala & Kawono, 2013; Schaper & Pervan, 2007). ICT adoption is related to the study of technology diffusion in many respects. Research ranges from the low level of aggregation, such as the intention and behaviour towards the use and adoption of technology, to the high level of aggregation, such as the technology itself, environment, infrastructure, social norms, and others (Davis, 1989; Tornatzky et al., 1990). It also encompasses many processes and stages, such as before the arrival of technology, during the use of technology, and after the use of technology (Csótó, 2010; Rogers, 1995). Most of the research also considers the use and adoption of technology as a voluntary rather than a mandatory requirement. However, in the global knowledge era, even the voluntary adoption of technology is necessary, and therefore, the scope of the research needs to be widened to include niche observations of attention and behaviour. It is important to view the adoption as not only from the perspective of the diffusion of technology, but also from the interaction of other antecedent factors examined in the study.

From the technology aspect, TOE describes the availability and characteristics of technology itself, which plays a major role towards technology adoption and innovation (Tornatzky et al., 1990). The technology characteristics emphasize this innovativeness in organizational context, that complements other theories such as DOI in technology adoption (Rogers, 1995). This explains why the TOE framework is closely related to

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other theories. Since there were few studies focusing on the characteristics of technology in small businesses, the researcher intends to blend together TAM into the TOE framework for this study (Premkumar, 2003; Shahawai & Idrus, 2010).

The common IS elements need to be explored during the study as part of the feasible and realistic understanding the nature of adoption, in the form of interaction between smallholder farmers and technology (Bellotti & Smith, 2000; Shahibi et al., 2007). The integration of IS elements will be essential to ensure the improvement of the existing body of knowledge and theory underpinned in this research. The IS elements will become moderator variables that interact with the technology factor that influence the ICT adoption among the smallholder farmer.

Therefore, the researchers choose the technology characteristic as independent variable which adopted from the TAM and TOE models. In a field where ICT acts as an enabler, technology should be moderated by other factor, namely, the IS element in the application system prototype developed which influence the farmers' attitude towards ICT adoption.

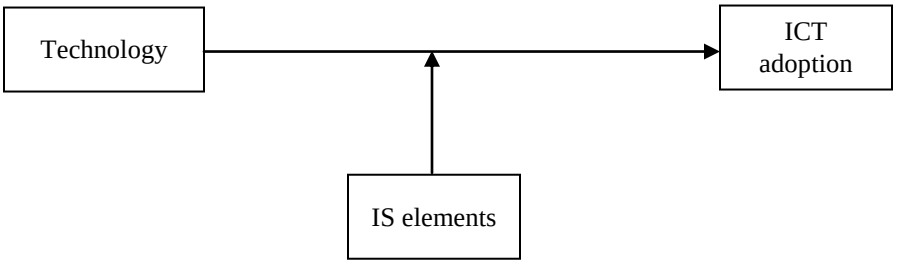

FIGURE 1. The Application System Interaction Effect towards Technology on ICT Adoption

Slope analysis is widely used by many scholars for analysing moderating variables and the interaction between independent variables and the 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 standardised while the standard deviation has to be near to 1. In this research, in order to interpret the effects of interaction, the researcher used the slopes analysis when testing the interactions because the interpretation of coefficients can be slightly simpler.

METHODOLOGY

The researchers used the multi method approach to be used in this study. The method of data collection is through survey questionnaire distributed to 336 smallholder farmers in Selangor state in Malaysia. After the questionnaire had been distributed and then collected, the data obtained were keyed into the statistical software SPSS version 21 with

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a network license provided by Pejabat Teknologi Maklumat (InfoTech), Universiti Teknologi MARA. The interaction analysis was strengthen through the slopes analysis introduced by Jeremey Dawson (2014) in order to understand further the nature of interaction effects of moderator variable towards independent variable and dependent variable.

Respondents and Data Sampling

The target population for the generalisation of the study is the smallholder farmers. They represent the agriculture entrepreneurs, and most of them are individual farmers. The double sampling method was chosen, as all TKPMs in Selangor are selected as the sample for this study whereby the nature of study exist in the study population as the setup area may avoid external factors that may influence the study (Sekaran, 2003).

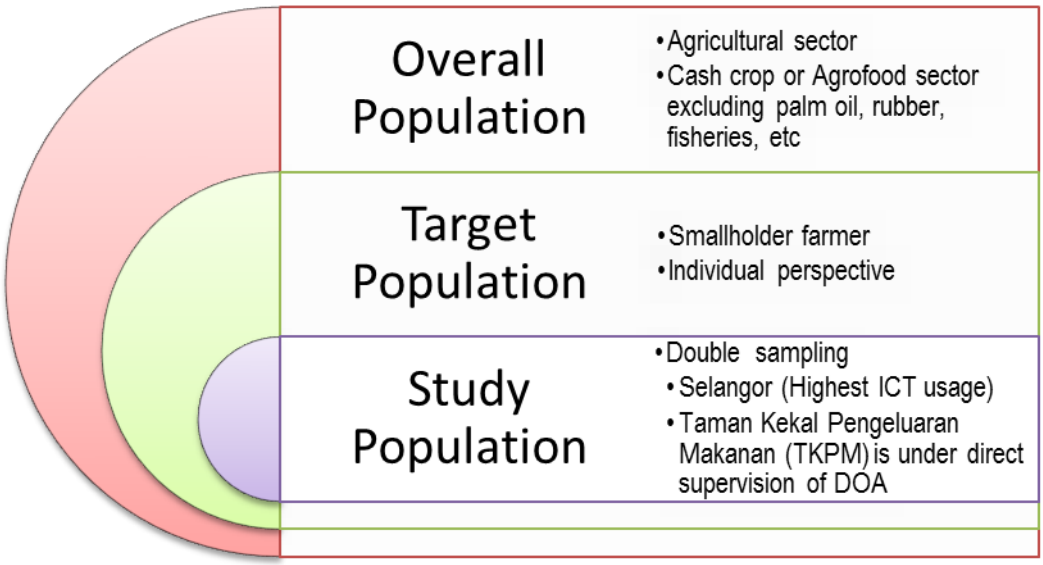

FIGURE 2. Sampling determination in this study

The researchers choose TKPM and Selangor due to the following reason:-

1. First developed state in Malaysia; Selangor Maju on 27th August 2005.
2. Highest agrofood sub-sector yield production (Selangor's Department of Agriculture, 2012).
3. Highest ranking of computer and internet usage in Malaysia (Malaysian Communications and Multimedia Commission (MCMC), 2013).
4. Highest ranking of broadband penetration in Malaysia (Malaysian Communications and Multimedia Commission (MCMC), 2013).

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Instrument

The instrument used in this study was adapted from multiple resources from previous researches (Avison & Fitzgerald, 1995; Davis, 1989; Sørensen et al., 2010, 2011). The questionnaire was selected due to the reliability and validity of the questionnaire in context of their previous study.

TABLE 1. The Content of Questionnaire

No	Construct & Sub-construct	Items	Source
1	ICT adoption • Productivity • Profitability • Innovativeness	4 items 4 items 4 items	• Gelb et al. (2008) • Dix (2007) • Palmer (2012) • Nchimunya (2012)
2	Technology • Accessibility • Perceived Usefulness • Ease of Use • End-user Support	4 items 4 items 4 items 4 items	• Davis (1989) • Sarason, Levine, Bahsam, & Sarason (1983)
3	Information System Elements • System Functions • System Features	5 items 5 items	• Sørensen et al (2010,2011) • Pedersen et al (2008) • Avison & Fitzgerald (1995) • Rob & Coronel (2007)

This survey used 5-point Likert scale, ranging from 1 which is strongly disagree (*sangat tidak setuju*) to 5 which is strongly agree (*sangat setuju*). The translation of the questionnaire between Bahasa Malaysia and English were done by a professional translator who possesses a certificate in 'General Translation Course' conducted by the Malaysia National Institute of Translation. The translation works were done by a professional translator to provide consistency in the data analysis process and safeguard the reliability of the questionnaire as measurement tools in this study.

ANALYSIS AND FINDINGS

The questionnaires collected were analyzed using SPSS statistical software. The result from Cronbach alpha's shows in TABLE 2 for N=209 respondents. The coefficient alphas for all type of variables were between .841 for environment and .874 for ICT adoption. As all variables showed results of between 0.6 and 1.0, the questionnaire was considered reliable and reasonable with sufficient internal consistency for this study. Meanwhile, the total reliability analysis through Cronbach Alpha result was 0.795 which is considered as high reliability.

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TABLE 2. Results of All Variables Reliability Analysis (N=209)

No	Variables	Type	No of item (s)	Cronbach's Alpha
1	ICT Adoption	Dependent	12	.874
2	Technology	Independent	16	.841
3	IS Elements	Moderator	9	.855

Model fit

Before the researcher interprets further the interaction effects with the simple slopes analysis, the researcher also conducted model comparison to compare multiple models that may exist in this study. The researcher conducted coefficient of multiple correlation comparison between the direct effect and multiple regression model for all variables in the proposed conceptual framework. The result of R, coefficient of multiple correlations takes values between 0 and 1 whereby the higher value or near to 1 is the better prediction and higher correlation coefficient between variables in this study.

In order to confirm the model fit is the best model, the result shows in TABLE 3 indicates the 2-way interaction effects used in this study is the better model. The interaction between IS elements with the technology gave the higher value of R. Therefore, the 2-way interaction effects gave better model in compare with the direct effect model in this study.

TABLE 3. Coefficient of Multiple Correlation Model Comparison

R	R Square	Dependent	Independent	Moderation/ Interaction	Description
.657	.432	ICT adoption	Technology IS elements	-	Direct effects model
.682	.465	ICT adoption	Technology	IS elements	2-way interaction effects*

* This model gave better model fit

Correlation Analysis

The simple correlation coefficient need to be conducted before the multiple regression analysis to understand the interaction effects. The Pearson Correlation, r value is the correlation assessment which normally between range of -1 and +1 (Pallant, 2005). TABLE 4 shows the Pearson correlation, r, significant between all variables. The Technology and ICT Adoption with r = .599, n = 208, p <.01, that is, a strong positive relation with a level of significance (p < .01). Furthermore, IS elements and ICT Adoption also showed a significant indicator of a strong and positive relationship between Technology and ICT Adoption with r = .555, n = 209, p <.01. The interaction effects (Technology x IS elements) relationship with ICT Adoption showed a significant indicator of a negative relationship with r = -.215, n = 208, p <.01. Meanwhile, the Technology and interaction effects showed non-significant indicator with r = -.079, n = 208, p >.05. However, the researcher does not concern in with this relation results. The researcher more concern on the result of interaction for IS elements that effect on ICT adoption.

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TABLE 4. Results of Pearson correlations between all variables

		ICT	TECHNOLOGY	IS ELEMENTS	TECH x IS ELEMENTS
ICT	Pearson Correlation	1	.599**	.555**	-.215**
	Sig. (2-tailed)		.000	.000	.002
	N	209	208	209	208
TECHNOLOGY	Pearson Correlation	.599**	1	.549**	-.079
	Sig. (2-tailed)	.000		.000	.257
	N	208	208	208	208
IS ELEMENTS	Pearson Correlation	.555**	.549**	1	.000
	Sig. (2-tailed)	.000	.000		1.000
	N	209	208	209	208
TECH x IS ELEMENTS	Pearson Correlation	-.215**	-.079	.000	1
	Sig. (2-tailed)	.002	.257	1.000	
	N	208	208	208	208

**. Correlation is significant at the 0.01 level (2-tailed).

Regression Analysis

Multiple linear regression analysis is used to analyze two or more variables to establish the strength of the relationship between them. The two variables are regularly represented as X and Y, with one an independent variable (or explanatory variable), and the other a dependent variable (or output/outcome variable) (Hair et al., 2009). The multiple linear regressions for all independent variables had correlation and contribution (46.5%) at significance ($p < .01$) towards ICT adoption among smallholder farmers in Malaysia. Using the enter method it was found that technology explained a significant amount of the variance in the ICT adoption by smallholder farmers in Malaysia ($F(3, 204)=59.117$, $p<.01$, $R^2=.465$, R^2Adjusted=.457). All variables were cantered in order to conduct the slopes analysis.

TABLE 5. Results of Pearson correlations between all centered variables

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.321	.040		107.431	.000
	TECH_C	.448	.069	.402	6.537	.000
	ISE_C	.331	.061	.333	5.431	.000
	TECH_ISE_C	-.212	.059	-.184	-3.568	.000

a. Dependent Variable: N_ICT

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R = .682
R square (R^2) = .465
Adjusted R square = .457
Standard Error of the Estimate = .535

TABLE 6. Variances analysis (ANOVA)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	50.844	3	16.948	59.117	.000[b]
	Residual	58.484	204	.287		
	Total	109.328	207			

a. Dependent Variable: ICT

b. Predictors: (Constant), TECH_ISE_C, ISE_C, TECH_C

Simple Slopes Analysis

Slope analysis is widely used by many scholars for analysing moderating variables and the interaction between independent variables and the dependent variable (Aiken & West, 1991; Dawson, 2014). All the data need to be centred so that the variables standardised while the standard deviation has to be near to 1. In this research, in order to interpret the effects of interaction, the researcher used the slopes analysis when testing the interactions because the interpretation of coefficients can be slightly simpler.

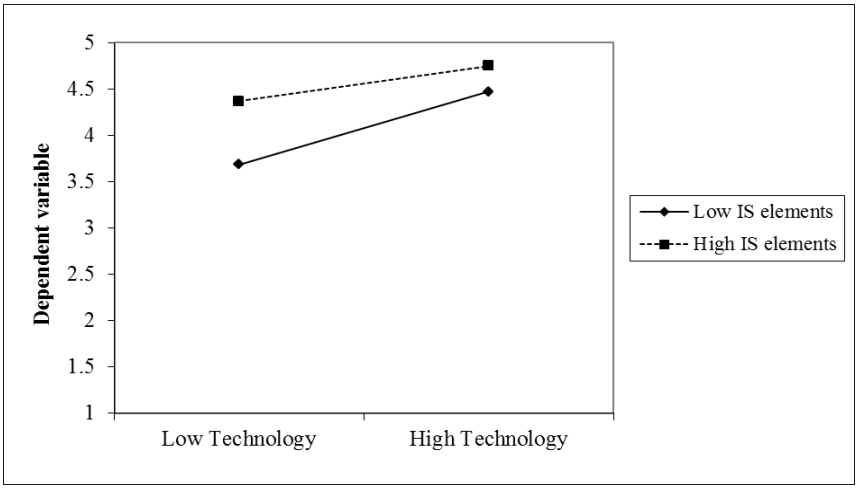

FIGURE 3. Slope 2-way interaction analysis result

The gradient of simple slope: 0.236, t-value of simple slope: 2.488, p-value of simple slope: 0.014. The p-value showed significant simple slope ($p<.05$). However, from the FIGURE 3, it showed that the slopes not crossing with each other. It was understand that the low IS elements will always low when the Technology low and high. It was also understand that the high IS elements will always low when the Technology low and high. From this result, the researcher concludes that the technology has no effect on ICT adoption for low and high IS elements of application system.

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CONCLUSION

This study was conducted to find out the interaction effects of IS elements towards Technology on ICT Adoption. The interaction effects gave the coefficient of multiple correlations values, R=0.682 and the R square = 0.465 which is better than the direct effect model. Furthermore, in order to understand whether, or to which extent the effect of a moderator variable towards independent variable on a dependent variable depends, the slopes analysis need to be conducted (Dawson, 2014). From the extended slopes analysis, the result showed that the technology has no effect on ICT adoption for low and high IS elements of application system.

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