

Mobile Broadband for the Farmers: A Case Study of Technology Adoption by Cocoa Farmers in Southern East Java, Indonesia

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Abstract

The objective of this paper is to examine the factors that affect Indonesia cocoa farmer intention to use mobile phone application. The main factors examined in this study are perceived usefulness (PU), perceived ease of use (PEOU), business factors and individual factors. The study sample consists of 191 respondents in thirteen cocoa farmer centers in southern East Java. Data were analyzed by employing Structural Equation Modeling (SEM). The findings revealed that the user intention on adopting mobile phone application especially by cocoa farmers is significantly impacted by social influence and this is in line with the massive growth the usage of social media application in Indonesia, other factors that determine the adoption are competitiveness pressure and cost perception. This research has a limitation that the generalizability of the findings is limited to the geographical scope of the sample. Based on findings, as the practical implications of this study, to get a higher rate on the adoption of mobile phone application, stakeholders need to ensure the benefit of technology adoption by providing more secure, more comfort, and more sounds like cloud ecosystem to increase the perception on ease of use and perception of usefulness. Novelty of this study is the combination of business factors and individual factors on the existing model of Technology Acceptance Model (TAM).

Keywords

Technology Acceptance Model (TAM), Five Forces Porter, Cocoa Farmer, Mobile Broadband, Structural Equation Modeling (SEM).

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Introduction

The emerging growth of mobile phone application and its' utilization are enabled by the convergence of rapid growth of broadband infrastructure development and penetration of mobile phone. Some studies highlighted the positive impact of broadband development to the economic development of a country.

Globalization will accelerate the utilization rate of information and communication technology which will contribute to the economy, for every 10% increase in broadband penetration as a main infrastructure of internet will increase GDP of 1%, and double increase in broadband speed will increase GDP up to 0.3%. This positive impact is due to automation and simplification of the process, increase of productivity, and better access on education and health facility (ADL, 2011). Based

on the study by Boston Consulting Group (2010) about economy value of internet in G-20 countries stated that internet penetration in Indonesia contribute 1.3% of total GDP in 2010 and projected to reach 1.5% of GDP in 2016. This number is relatively lower compared to other G-20 countries which is 5.3% of total GDP, and potentially reach a higher rate if we compare to other G-20 countries achievement of average 5.3%.

Indonesia is an agricultural country given the role and contribution of the sector to the economy. Daryanto (2009), as cited in Nabhani et al. (2015A), the agricultural sector has always been a mainstay in the development of the national economy despite facing greater challenges as the influence of globalization which requires the necessity of building a strong competitiveness and a specific requirement in building the competence in agro-technopreneurship is concern and awareness

of the e-commerce, information technology and application of the latest technology (Gumbira-Said, 2010) as cited in Nabhani et al. (2015A).

One of the seed Indonesia agriculture commodities is cocoa which put Indonesia as a top three global producer country (ICCO, 2012) and in Indonesia, this commodity plantation is dominated by farmers rather than estates or corporations (Panlibuton, 2004).

USAID (2013), in their study reported that information and communication technology help farmer in expanding their market by finding new buyers, getting the highest price and trading management, compliance, and better production management. Other benefit is access to technology and information which will expand their basic income as part of their sustainability strategy (UNDP, 2012), and according to FAO (2013), the role of information and communication technology in agriculture are better production system management, access to the market and financial institution; and cellular phone is the most favorite device use by the farmers in their social networking with other farmers or agriculture expert. It is also found that the utilization of m-commerce remain as the epicenter of ongoing digitalization of peoples' life (Pousttchi et al., 2015).

Nabhani (2015B) states that there is a possibility to explore the massive development of broadband infrastructure to give the benefit to Indonesia cocoa farmers by giving them access to a wider market and latest technology, it might increase the degree of complexity of production process but on the other hand will give them access to niche markets that appreciate a more sophisticated type of product.

Davis (1989) introduced Technology Acceptance Model (TAM) with a background of recent development on computer technology and its adoption by organization and any conducted research could not explain the resistance or acceptance on a new system. He proposed that user motivation could be explained by the following factors: perceive ease of user, perceived usefulness and attitude toward using with a hypothesis that the intention behavior is a main factor that will affect the actual system use. Somehow, this intention is influenced by two main perceptions which are perceive usefulness and perceive ease of use. These two factors were affected by the characteristic of system design represented by external variables. This study analyses the cocoa farmer's acceptance

on massive mobile phone application penetration in Indonesia using the expansion of basic theory of Technology Acceptance Model developed by Nabhani (2015A).

Materials and methods

This study analyzes the farmer's acceptance on mobile phone application technology using the modified Technology Acceptance Model developed by Nabhani (2015A), a model that combined the business factors and individual factors as the latent variables that impacting user's intention on adopting new technology through Perceived Usefulness (PeU) and Perceived Ease of Use (PEOU) on introduced technology.

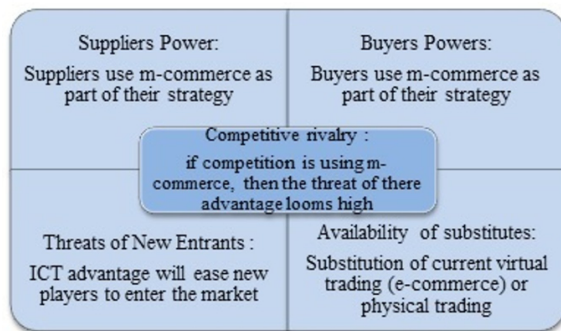
Based on the problem statement mentioned above, the research objective of this paper is to identify and determine the impact of business factors and individual factors that influences the adoption of mobile phone application by cocoa farmers.

Literature review

Nabhani (2015A) developed a modification of Technology Acceptance Model that initially a theory and model introduced by Davis (1989) by adding business factors and individual factors as the determinant factor of Perceived Usefulness (PeU) and Perceived Ease of Use (PEOU) that finally will impact to user's intention on adopting introduced technology.

Business factors

To define the business factors that will influence an individual/organization in technology adoption decision, this paper uses Five Forces Porter as the key variables. In order to secure their advantage in the market place, five competitive forces were those that organizations needed to heed Porter's (1979). This will include the threat of new entrants, bargaining power of customers, bargaining power of suppliers, threat of substitute products or services and jockeying among current customers. A firm need to put a plan of action in a strategy against these forces, positioning the firm with their capabilities to provide the best strategy over the competitive forces, influence the balance through strategic moves in order to improve the company's position, and anticipate shifts in the factors underlying the forces and responding to them (Porter, 1979) (see Figure 1).



Source: Swilley, 2007

Figure 1: Mobile commerce adoption using Five Forces.

Swilley (2007) included the five forces Porter as part of business environment that were taken into account during the adoption of m-commerce with the following considerations:

- Threats of New Entrants - mobile commerce service will ease new players enter into the market.
- Power of Suppliers – if it is already adopted by the suppliers, it will become a competitive advantage to use the same communication technology.
- Power of Buyers – as adopted by the buyers, a firm need to consider to user the same technology
- Competitive rivalry - if competition is using m-commerce, then the threat of the advantage looms high
- Availability of substitutes - is a substitute of current virtual trading (e-commerce) or physical trading

Individual factors

This paper addresses some findings from previous researches as follow:

1. Perceived cost

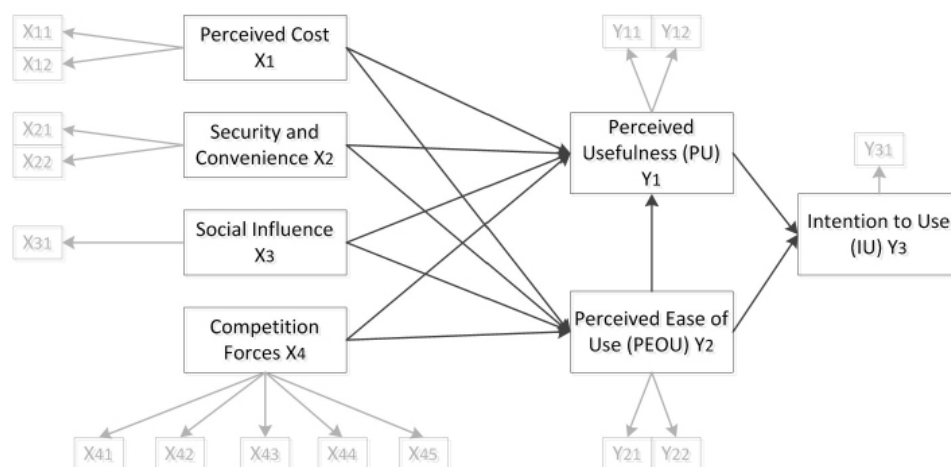
Wymer and Regan (2005) in their research concludes that from all the factors affecting the m-commerce adoption that consistently exist across all groups was cost perception as the barrier. Khalifa and Shen (2008), combine the variables of Theory of Planned Behavior (TPB) which are subjective norm and self-efficacy into Technology Acceptance Model (TAM). Five external variables identified on the research were perceived cost, privacy, security, efficiency, and convenience. A cross-sectional survey study to B2C respondents in Hong Kong was performed to test the research model. Islam (2011) in his research on m-commerce adoption in Bangladesh by mobile users used the variable of perceived cost, comprehensive and updated information, security and convenience as key factors on m-commerce adoption.

2. Social influence

The social influence is determined by how any human society use any new system and how it is perceived by an individual for making improvements in their living condition and status (Sadia, 2011) and most people uses any system or services because of the opinion of others or by observing different people in different situations (Davis et al., 1989)

3. Security and convenience

These variables were raised by Khalifa and Shen (2008), Islam (2011), Yu (2013) and Al



Source: own processing

Figure 2: Conceptual framework.

Khasawneh (2015) on their research in examining the m-commerce adoption. Security refers to the safety of exchanged information (Khalifa and Shen, 2008) especially on sensitive personal info (Yu, 2013) such as credit card number, address, and phone number, while convenience refers to the extent to which m-commerce makes easier for customers to conduct transactions compare to traditional way (Khalifa & Shen, 2008) (see Figure 2).

Research method

This study employed descriptive quantitative data analysis. Hypotheses were developed from theoretical reviews and empirical studies. Subsequently it followed a confirmatory strategy of research in which a process of confirming or disconfirming hypotheses is employed to answer previously identified research questions.

1. Sampling procedure

In this study, a non-probability sampling was employed, and the sampling method used was convenience sampling. The sampling frame consisted of farmers in thirteen cocoa centers in southern East Java (Bakung, Gandusari, Kademangan, Kediri, Kesamben, Malang, Ngantang, Selopuro, Selorejo, Srengat, Trenggalek, Tulungagung, and Wonotirto). The survey method used a standardized questionnaire to collect desired information from respondents. In anticipation of a low response rate, the personal survey interviews were conducted between Octobers to December 2015. Prior to conducting a full scale survey, a pilot-test to 10 respondents was executed to solicit feedback in terms of understanding of the survey wording and evaluate the measurement reliability and validity.

2. Operational variable and definition

All data was generated from questioners and was designed, based and modified on previous studies.

- **Intention to use.** It is users' feeling on their encouragement to utilize the mobile commerce services, users' impression, prefer to interaction through m-commerce, and expect their stakeholders to use it. Adopted from Davis (1989) using Likert scale (1-5)
- **Perceived usefulness.** It is the level of confidence of users that the service will provide benefits to the business, work faster, more efficient, easier, more effective, and give the overall benefit. Adopted

from Davis (1989) using Likert scale (1-5)

- **Perceived ease of use.** The level of confidence of users that the service is easy to use consist of easy to learn, easy to administer, easy to interact with, easy to become proficient, and easy to understand in overall. Adopted from Davis (1989) using Likert scale (1-5).
- **Business pressure.** Business pressures to adopt m-commerce services, it means new players in the market, supplier power, buyer power, competitors with m-commerce, substitution to e-commerce service that already exists. Adopted from Swilley (2007) using Likert scale (1-5)
- **Perceived cost.** Perceptions about the cost of technology adoption such as the price of smart phones and internet connection tariff. Adopted from Islam (2011), Khalifa and Shen (2008), and Li et al. (2007) using Likert scale (1-5)
- **Security and convenience.** Level of security and convenience in doing transaction via mobile device. Adopted from Chen et al. (2013), Sadia (2011), Wei (2009), and Bigne et al. (2007) using Likert scale (1-5)
- **Social influence.** User adoption impacted by their community adoption on m-commerce. Adopted from Sharma and Gupta (2003), Sadia (2011) and Yu (2013) using Likert scale (1-5).

3. Hypotheses

This research examines the following hypothesis:

- H₁: Cost perception has positive impact to perceive usefulness (PU)
- H₂: Safety and security have positive impact to perceive usefulness (PU)
- H₃: Social influence has positive impact to perceive usefulness (PU)
- H₄: Cost perception has positive impact to perceive usefulness (PU)
- H₅: Cost perception has positive impact to perceive ease of use (PEOU)
- H₆: Safety and security have positive impact to perceive ease of use (PEOU)
- H₇: Social influence has positive impact to perceive ease of use (PEOU)
- H₈: Competitiveness pressure has positive impact to perceive ease of use (PEOU)
- H₉: Perceive ease of use (PEOU) has positive

impact to perceive usefulness (PU)

H₁₀: Perceive ease of use (PEOU) has positive impact to intention to use (IU)

H₁₁: Perceive usefulness (PU) has positive impact to intention to use (IU)

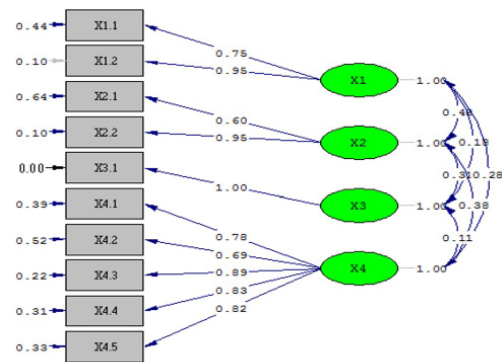
Results and discussion

Results

Based on descriptive analysis on the sample's profile, this paper reveals some high level findings. Firstly, 48% of the age of cocoa farmers is above 55 years old, meaning that Indonesia cocoa is facing problem on farmer regeneration (Nabhani et al., 2015B). Secondly, in term of education level, 60% of sample are below senior high school, Zhang (2009) concluded that the lower educational level the lower their technology adoption capability. Thirdly, based on in-depth interview with cocoa farmers association, the feasibility level of cocoa plantation will meet the scale if the plantation area is above 0.5ha and it is represented by 24% of sample size. Out of total 193 respondents, mobile phone penetration is 60% and smart phone penetration is 24%. To gain a better insight of respondent and firm profiles, distribution frequency was used and the results are shown in table 1.

Validity and Reliability Test

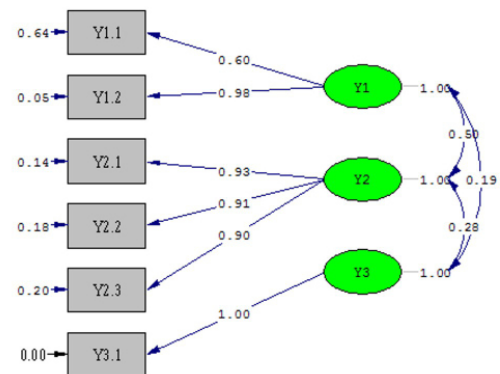
The statistic procedures in LISREL were utilized on conducting the validity and reliability test. Based on the result as shown in the table 2 and table 3, it is concluded that all the indicators of both exogenous and endogenous variables in the model are valid (SLF ≥ 0.50 dan $|t_{calc}| > 1.96$) and reliable (CR ≥ 0.70 and VE ≥ 0.50).



Chi-Square=42.65, df=29, P-value=0.04907, RMSEA=0.064

Source: calculation result

Figure 3: SLF of exogenous variable in farmer's adoption model.



Chi-Square=11.59, df=7, P-value=0.11494, RMSEA=0.075

Source: calculation result

Figure 4: CFA of endogenous variable in farmer's adoption model.

Individual profile				Business profile			
		Count	% age			Count	% age
Age	<25	16	8%	Year of business	<1	5	3%
	25-55	84	44%		5-1	69	36%
	>55	91	48%		>5	117	61%
Gender	Male	51	27%	Plantation area	<500m2	88	52%
	Female	140	73%		500m - 0.5ha	41	24%
Education	< High School	115	60%		0.5 - 1 ha	10	6%
	High School	69	36%		>1ha	30	18%
	Diploma	2	1%	Communication device	Feature Phone	70	37%
	Bachelor/Master	5	3%		Smartphone	46	24%
	Doctoral Degree	0	0%		No Phone	75	39%

Source: calculation result

Table 1: Respondent profile.

Variable	Indicator	Loading factor	ei	Tcalc	CR	VE
Cost perception	X1.1	0.75	0.44	9.17	0.843	0.731
	X1.2	0.95	0.1	13.69		
Security and safety	X2.1	0.6	0.64	5.9	0.765	0.63
	X2.2	0.95	0.1	8.35		
Social influence	X3.1	1	0	15.17	1.000	1.000
Competitiveness	X4.1	0.78	0.39	9.17	0.901	0.647
	X4.2	0.69	0.52	8.2		
	X4.3	0.89	0.22	11.79		
	X4.4	0.83	0.31	11.07		
	X4.5	0.82	0.33	10.44		

Source: calculation result

Table 2: Validity and reliability of exogenous variable.

Variable	Indicator	Loading factor	ei	Tcalc	CR	VE
Perceive ease of use (PEOU)	Y1.1	0.60	0.64	5.58	0.783	0.725
	Y1.2	0.98	0.05	7.60		
Perceive usefulness (PU)	Y2.1	0.93	0.14	12.93	0.896	0.812
	Y2.2	0.91	0.18	12.41		
	Y2.3	0.90	0.20	12.20		
Intention to use (IU)	Y3.1	1.00	0.00	15.17	1.000	1.000

Source: calculation result

Table 3: Validity and reliability of endogenous variable.

Path Coefficient and T-test

The conceptual structural equation model was tested using LISREL 8.80, as shown in above table, the chi-square (χ^2) is equal to 101.48 with the degree of freedom (df) is equal to 70, so that the χ^2/df (chi-square to freedom ratio) is 1.45 which is less than the cutoff good fit < 3.0 , this indicates a good fit between the model and the collected data (Kline, 2004). As shown in table 4, seven out of eleven hypotheses received significant supports (H_1 , H_2 , H_3 , H_6 , H_7 , H_9 , and H_{11}), while four hypotheses were rejected (H_4 , H_5 , H_8 and H_{10}).

Path		Path coefficient	T calculation	Remark
X1 → Y1	γ_{11}	0.38	5	Significant
X2 → Y1	γ_{12}	0.15	1.83	Significant
X3 → Y1	γ_{13}	-0.16	-2.43	Significant
X4 → Y1	γ_{14}	0.09	1.17	Not Significant
Y2 → Y1	β_{12}	0.16	1.37	Not Significant
X1 → Y2	γ_{21}	0.3	4.52	Significant
X2 → Y2	γ_{22}	0.27	4.33	Significant
X3 → Y2	γ_{23}	-0.09	-1.39	Not Significant
X4 → Y2	γ_{24}	0.29	5.9	Significant
Y1 → Y3	β_{31}	0.14	0.65	Not Significant
Y2 → Y3	β_{32}	0.31	2.36	Significant

Note: if $|t_{calc}| > 1.96 \rightarrow$ significant

Source: calculation result

Table 4: Evaluation on path coefficient and tcalc.

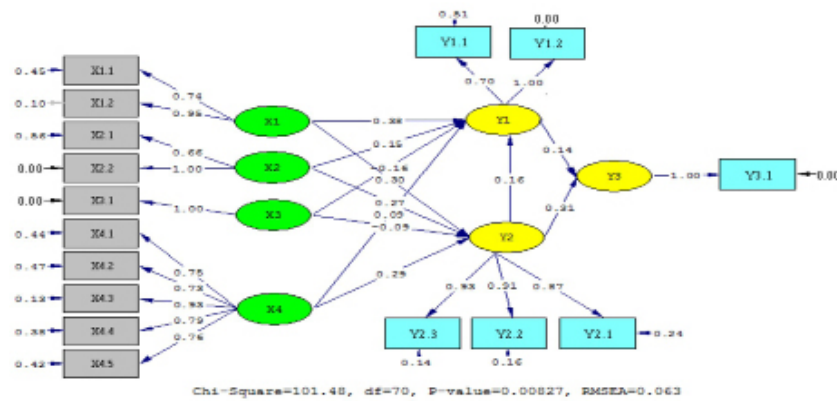
Goodness of Fit (GOF)

Based on the GOF table calculation result as presented in table 5, all indicators indicates that the model is good and fit. The questionnaire result is able to confirm the developed theory. The model shows a good fit between the conceptual model and the data with RMR = 0.044, RMSEA = 0.063, GFI = 0.99, AGFI = 0.98, CFI = 1.00, NFI = 0.98 (Designed cutoffs: RMR ≤ 0.05 or ≤ 0.1 , RMSE RMSEA ≤ 0.08 , GFI ≥ 0.90 , AGFI ≥ 0.90 , CFI ≥ 0.90 , and NFI ≥ 0.95 , Hair et al. (2010)).

Discussion

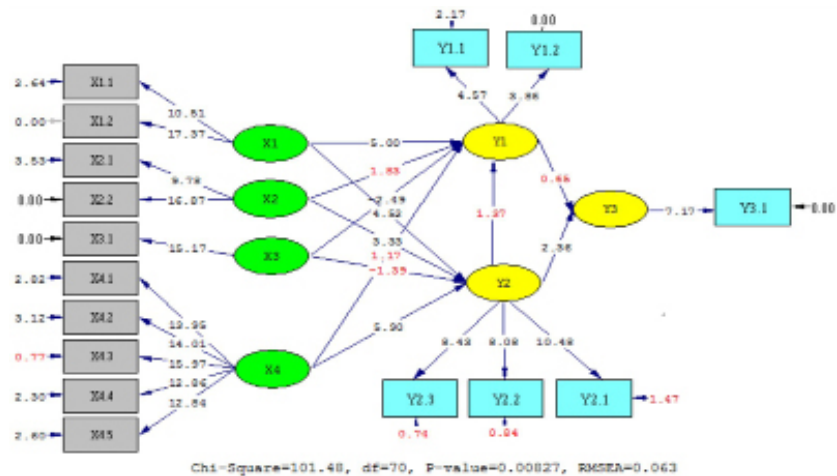
This study is performed to examine the factors (both business environment and individual) influence the acceptance criteria of the mobile phone application and in line with some recommendation from previous studies that an empirical study shall be conducted to some specific products/services in specific industries (i.e. fashion or gadget) (Yu, 2013) with more heterogeneous respondents (Zhang, 2009) with visibility to business performance post adoption (Khalifa & Shen, 2008) (Swilley, 2007) to reveal the characteristics of specific communities in adopting new technology.

Perceive ease of use (PEOU) is positively influenced by cost perception, security & safety, and social influence, where social influence was found to score the highest mean among other factors.



Source: calculation result

Figure 5: Standardized Loading Factor (SLF) of the model.



Source: calculation result

Figure 6: Tcalc of farmer's adoption model.

Goodness-of-Fit	Cut-off Value	Result	Remark
RMR(Root Mean Square Residual)	$\leq 0,05$ or $\leq 0,1$	0.044	Good Fit
RMSEA(Root Mean square Error of Approximation)	$\leq 0,08$	0.063	Good Fit
GFI(Goodness of Fit)	$\geq 0,90$	0.99	Good Fit
AGFI(Adjusted Goodness of Fit Index)	$\geq 0,90$	0.98	Good Fit
CFI (Comparative Fit Index)	$\geq 0,90$	1	Good Fit
Normed Fit Index (NFI)	$\geq 0,90$	0.98	Good Fit
Non-Normed Fit Index (NNFI)	$\geq 0,90$	1	Good Fit
Incremental Fit Index (IFI)	$\geq 0,90$	1	Good Fit
Relative Fit Index (RFI)	$\geq 0,90$	0.97	Good Fit

Source: calculation result

Table 5: Fittest criteria on the SEM model.

These findings confirmed prior empirical studies conducted by several researchers (Khalifa and Shen (2008), Islam (2013), and Sadia (2011). In contrary, social influence is insignificant as a determinant of Perceive Usefulness (PU), while other factors

(cost perception, security and safety, and competitiveness pressure) are significant to Perceived Usefulness (PU).

Perceived Usefulness (PU) significantly influences

Intention to Use (IU), while Perceive Ease of Use (PEOU) is insignificant. Interesting fact that most of respondents perceive that ease of use on mobile phone application is not determined by the competition, but they perceive that this technology is useful if their competition environment use it as part of the business which drives them to have the intention to use mobile phone application. Based on the finding in the field, most of respondents that intent to or already use mobile phone application prefers to get benefit on access to information such as update commodity price and technology as other players in the industry may do it.

In term of theoretical implications, it can be considered that the major novelty in this research is the intention to explore the adoption of mobile phone application comprehensively. This study extends the current literature in two areas. Firstly, this research used a basic version of the TAM with the combination of business environment factors and individual factors (Nabhani et al., 2015B). Secondly, this paper also examine the impact of adoption to their business performance, existing smartphone users agree that the extend utilization of mobile internet in their business improve their overall business performance.

Managerial implications on this study, based on the result of this research and past studies literature review about the different factors effecting the m-commerce adoption, this paper suggest that the supporting industry along the value chain (infrastructure provider, device manufacturer and retailer, and application developer) should try to make their services better by creating an ecosystem of mobile phone application in general (Zhang et al., 2002). The three main pillars in internet ecosystem are telecommunication network infrastructure, device penetration, and supported by application. By bringing those together, it will make the mobile phone transaction

become easier and useful. This will increase the awareness about those services and will push their customer loyal to their services in accepting and adopting this technology for a long term period. These stakeholders also need to campaign the benefit of technology adoption to increase the customer awareness. Community based approach is another primary consideration in deploying this application. Individual or organization which has intention to adopt this technology should assess the projected benefit and ease of use of m-commerce in their business. Government intervention absolutely is a necessary to push optimum utilization of broadband for the benefit of farmer in Indonesia (Stoica et al., 2005).

Conclusion

This study employs a non-probability sample of cocoa farmers in southern East Java. The decision to use convenience sampling was chosen due to the respondent's availability during the survey. This method may limit the generalizability of the results of this study. Since this study only examines the mobile phone application usage at farmer level, future research that includes more sample size on trader (local trader, district trader, and exporter) will enhance our understanding in this specific industry. Secondly, the fact from culture perspective that people in East Java is tend to be more communal, it will be better to put a cultural perspective as part of variable on the determinant of technology adoption (Frolick and Chen, 2004). Finally, future research in different sub-sectors of agriculture will broaden our perspectives on the importance of broadband/internet adoption, thus could give us better insight of how broadband/internet adoption could have different or the same impacts across different industries with the inclusion of other factors such as environmental and technological evolution (Alfahl et al., 2012).

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