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# Enterprise Resource Planning (ERP) Adoption in the Thai Agricultural Sector

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**Abstract**
The Thai economy has been trying to adapt to the disruptive emerging new technologies. To this end, the Thai government has been actively delivering several modern technological policies and structural changes in the public administration. In the business sector, all business organizations have also been required to transform their current enterprise management so as to exploit the benefits of the technology stream and maintain their resilience. This study examines an actual reaction. More specifically, it focuses on the use intention of the agricultural sector with regard to enterprise resource planning (ERP) technology, which is meant to enhance their ordinary management basis. The technology acceptance model (TAM) is the main theory used to make this determination, along with three success factors of ERP study: government support (GOV), business process re-engineering (BPR) and training (TRA). They are deployed as key indicators to predict intention characteristics of the agricultural enterprise. A questionnaire is used to survey the rice mill industry, which is a representative of the agricultural industry. The results are evaluated with the path analysis under the structural equation modeling technique. The findings indicate that three ERP success factors and two factors from the TAM have both positive direct and indirect relationships to the possibility for agricultural organizations to deploy ERP. In terms of managerial implication and policy recommendation, BPR is determined as the key parameter to fulfill the intention of ERP adoption.

**Keywords**: Enterprise Resource Planning (ERP), Technology Acceptance Model (TAM), Business Process Re-engineering (BPR), Use Intention (UI), Behavioral Intention (BI).

## 1. Introduction

As a standard corporate management program designed to enhance internal competitive advantages by integrating all business units together under holistic business planning and operation, Enterprise Resource Planning (ERP) has been widely adopted by organizations with complex structures (Davenport, 1998). ERP, however, has been applied on a small scale (and in many cases unproductively) by small and medium-sized enterprises (SME) and rural businesses. In addition, the popularity of applying ERP into these businesses is low. Yet, in developing countries, although SMEs approximately represent 90-95% of all business organizations, they make a significantly low contribution to the national economies in comparison to big corporations (World Bank, 2016). Take for example Thailand, the country on which this study focuses. In 2017, Thai SMEs contributed 42.4% of the national gross domestic product (GDP), which is slightly less than the 43% GDP contribution of large companies (OSMEP, 2018). What these figures suggest is that the growth rate of the Thai economy largely depends on the growth rate of SMEs, which clearly require further developments for the sake of the national economic prosperity of great import in this study, the GDP contribution of the agricultural sector ranges between 11.4% and 8.7% of the total GDP (OSMEP, 2018).

This makes improving the competitive advantage of agricultural SMEs a national concern. Whilst less competitive with the other sectors in term of funds, business management, and technology deployment, agricultural businesses enjoy an advantage in terms of location, business size and structural adjustment. So, once, an appropriate business management system or software is in place and fully adopted, this sector could fully benefit from the innovative economy, especially in terms of cost structure. This raises the issue of whether the adoption by these SMEs and rural businesses of ERP would improve their performance. Changing from existing business operations to an ERP system, however, can be very difficult and has no standard pattern yet. No study has concretely addressed the adoption of ERP by Thai agricultural businesses, a sector, which in developing countries is relatively neglected by this modern business system (Duangekanong, 2014). In Thailand, governmental efforts to develop the agricultural sector are nothing new. They started long ago with a policy called the National Economic Development Program (NESDP), concerned in part with the export of agricultural products to boost the country's economic capability. There were, however, several undesirable aftermaths associated with this policy, such as highly degraded natural resources (NESDB, 1961).

In an attempt to address prior shortcomings, the Thai NESDP subsequently adopted a new policy promoting sustainable agriculture, creating value-added activities, and using information technology (IT) to create an innovative agriculture and smart farms. This policy offered many opportunities for the Thai agricultural industry to change its business strategy and utilize more advanced management programs (NESDB, 2007). With its focus on industry 4.0, the current national development policy presents even more opportunities for innovation, IT adoption, and the emergence of breakthrough systems (NESDB, 2016). These changes in the Thai national policy associated with industry 4.0. provide the perfect scenario for introducing the use of the ERP system or other advanced business approaches as a revolution in the agricultural sector. ERP is widely accepted as giving out sustainable benefits for systematic management as it produces better process efficiency toward the quality of decision making at each layer of an organization (Hsu, Lai, and Weng, 2008; Ngai, Law, & Wat, 2008).

Alternatively, a communication process in the agricultural organization is indispensable to enable an effective ERP communication diffusion (Verdouw, Robbemond, & Wolfert, 2015). An obstruction to the growth of the agricultural ERP market, however, is that the standard ERP package cannot be fully deployed in this sector. Besides, most ERP software has proven to be unproductive for this business category. Consequently, this study seeks to identify the reasons why ERP is not embraced in the Thai agricultural sector. For a justification of ERP capability in the Thai agricultural scenario, possible influences with regard to the intention of ERP – government, the theory of Reasoned Action (TRA), business process re-engineering (BPR), perceived ease of use (PEOU) and perceived usefulness (PU) – are needed to verify and explain an interconnected relationship in enabling the use of ERP with in this sector.

## 2. Literature Review

This section first focuses on ERP and then turns to the Technology Acceptance Model (TAM).

### *- Enterprise Resource Planning (ERP)*

ERP was developed from a combination of Material Requirements Planning (MRP) and Manufacturing Resource Planning (MRP) by the Gartner Group, Stamford, Connecticut, USA, in order to re-systematize its internal system to empower internal business operation. In 1987, two German companies; Siemens and SAP, cooperated to create an enterprise-wide

system called 'ERP'. Sales of the program have since reached billions. ERP can be defined as the integration of multi-functions in an organization or single database and interconnected platforms of business (Davenport, 1998). ERP is highly beneficial to assimilate all functions and locations, especially with respect to ordinary systems (Gattiker & Goodhue, 2002). ERP provides support to all organizational activities, such as manufacturing and logistics, finance and accounting, sales and marketing, and human resources (Jacobs and Whybark, 2000; Markus, Axline, Petrie, & Tanis, 2000). Each process is directly connected with one another at a real time operation under a systematical optimization that lead to work precision, data collection, rapid adjustment, forecastability, time and budget optimization (Madanhire & Mbohwa, 2016).

For SMEs, ERP is tailored to accommodate the specific needs of each business requirement by decomposing completed ERP modules to suit each organizational component. All of the sub-modules are systemically configured with ERP principal, especially in the process optimization among all interconnected activities under the real time data collection and optimization (Huang & Yasuda, 2016). Several ERP systems, however, have failed to be business drivers because of workers' resistance (Stratman & Roth, 2002). According to Al-Mashari and Zairi (2000), "successful ERP operation arises from an appropriate change management" (p.306). Using change management strategies to overcome workers' resistance and enhance the infusion of ERP in the workplace is thus another solution to reduce failure of ERP adoption. After conducted a non-adept study for elaborating a change management strategy behind the success of ERP implementation, Adel (2001) concluded that dealing with resistance from the workforce is an inextricable strategy.

***- Motivations for ERP-Driven Business Change***

The ERP configuration process directly affects how ERP will constrain or transform an existing business practice. A change in the business process is justified by the fact ERP cannot be fitted with the exiting process (Gattiker & Goodhue, 2002). Figures of ERP adoption successes disclosed by SAP show that 80% capability to be accommodated in the original business process. However, more than half those figures required ERP adjustment (Scott & Kaindl, 2000). ERP practitioners and experienced managers tend to believe that original practices are usually incompetent and require process re-engineering along with a modification of the ERP process installment for the sake of the business performance and for establishing new standards in each organization (Connolly, 1999; Pereira, 1999).

***- ERP in the Agricultural Sector***

The workforce quality in the agricultural sector tends to be relatively lower than in the industrial sectors. Business patterns proceed by feeling and experiences rather than through a work standard, data collection and analysis. Those constrains run counter to the main purpose of the initial ERP developed from manufacturing computer applications (Shehab, Sharp, Supramaniam, & Spedding, 2004). An empirical research on adopting ERP to farms conducted by Hyeung, Rock, and Chan (2015) suggest the following five possible effects on ERP applied to farm businesses:

1. ERP leads to the creation of a work standard and business process optimization;
2. ERP contributes to information accuracy and centralized information control;
3. ERP contributes to better inventory management;
4. ERP adoption can improve operation efficiency and optimize control of all equipment;
5. Time in the process cycle is monitored and readjusted to meet the fastest time and make the process flow efficiently from the mutual information sharing system;
6. The cycle time of a whole business is efficiently optimized and promptly adjusted as per the information sharing system of ERP.

***Critical Success Factors in ERP***

According to studies by Yu and Tao (2009) and Shatat (2015) conducted to identify the critical success factors (CSFs) that affect the ERP system's implementation success, a criteria is to judge by degree of citation each factor in ERP literature. A magnitude of citation is ranked from high to low; top management support, project management business process reengineering, user training & education and user involvement are at the high-rated degree of citation in the ERP literature (Shatat, 2015). Table 1 presents the conclusion of the main factors and the degree of citation for each factor in the ERP literature.

**Table 1**: Conclusion of CSFs and Degree of Citation for Each Factor in ERP Literature (Shatat, 2015;Yu & Tao, 2009)

| **CSFs in Literature** | **Degree of Citation in Literature** |
|---|---|
| Top Management Support | High |
| Project Management | High |
| Business Process Reengineering | High |
| User Training & Education | High |
| User Involvement | High |
| Business Plan & Vision | Medium |
| Careful Package Selection | Medium |
| Change Readiness & Culture | Medium |
| Clear Goals & Objectives | Medium |
| Learning Competency | Medium |
| Minimal Customization | Medium |
| Monitoring & Evaluation of Performance | Medium |
| Project Champion | Medium |
| Strategic IT Planning | Medium |
| Teamwork & Composition | Medium |
| Vendor Support | Medium |
| Appropriate Business & IT Legacy Systems | Low |
| Data Analysis & Conversion | Low |
| Education on new Business Processes | Low |
| Partnership with Vendor | Low |

***Technology Adoption***

Technology adoption is defined as changes in logical thinking influenced by information about technological perception and by the technology itself. Technological perception is, theoretically, initiated by size, driving capacity, technical units, delay, binary operation and path dependency information between input and output. This decisive information has to be judged by a transformation at the lowest technological needs to an appropriate use (Dodds, Monroe, & Grewal, 1991). In addition, technology adoption is concerned as preliminary foundation for ERP adoption because ERP concept is originated from an integration of the system thinking and technological use.

***The Technology Acceptance Model (TAM)***

The technology acceptance model (TAM) was officially proposed by Davis (1989). This approach was effectively used to estimate individual computer acceptance behavior (Ajzen & Fishbein, 2000). The TAM was initially created from a combination of intention elements on the basis of the Theory of Reasoned Action (TRA) developed by Ajzen and Fishbein (2000). It is also based on perceived usefulness (PU) and perceived ease of use (PEOU) as conceived by Venkatesh and Davis (2000). In the TAM structure, an individual's actual behavior intention (BI) and use intention (UI) toward the technology can be forecasted by PU and PEOU. Davis (1989) defines PEOU as "the degree to which a person believes that using the system will be free of effort" (p. 130). It has also been defined as "the degree that an individual intends to use the product with effortless as well" (Davis, Bagozzi, & Warshaw, 1989, p. 990).

PU is "the degree to which a person believes that using a particular system could raise their job performance" (Davis, 1989, p. 330). It is considered to be a key element to increase job performance and motivation at an individual level. It can potentially be influenced by PEOU since a user who perceives an ease of use will appreciate a convenient feeling and eventually believe in a system usefulness (Robey & Farrow, 1982). UI is another element affecting a persons' usage of each specific technology. It is referred to as "a measure of the strength of one's intention to perform a specified behavior" (Davis, 1989, p. 330). As an extension of the TAM, the Unified Theory of Acceptance and Use of Technology model (UTAUT) exploits UI by using constructs from Davis (1989) that are widely accepted in several of technology acceptance studies (Venkatesh et al., 2003). As a result, the TAM is the most compact and precise model among other technology adoption theories such as UTAUT, TRA, and Model of Personal Computing Utilization (MCPU), for making the extended model grounded from the motivational purposes (Ong and Lai, 2006; Pituch & Lee, 2006; Sánchez & Hueros, 2010).

***Government Support (GOV)***

Government Support (GOV) is a crucial economic engine. This support comes in the form of policies and special privileges. It is an external power that is distinct from corporate capability and could make a significant change to national development, especially in developing countries (Hyeung et al., 2015). Since government power in developing countries is strong up to a certain level, information technologies and other innovations are also mutually vital through national support schemes, particularly through receiving extra resources through incubation government programs (Besley & Burgess, 2002).

***Business Process Re-Engineering (BPR)***

Business Process Re-Engineering (BPR) was initiated by Hammer (1990) who stated that "re-engineering works don't automate and obliterate" (p.107). Hammer (1990) and Manganelli and Klein (1994) defined BPR as a radical strategy adjustment giving value-added within the business process. BPR also has an ability to reshape work systems, policies, and organizational configurations to modernize an existing workflow and organizational competency (Manganelli & Klein, 1994). In terms of business competency, Hammer and Champy (2009) found that BPR has resulted in a reconsideration and a radical reform of the business processes to achieve significant improvements in terms of cost, quality, service, and speed. In terms of competitive advantage, Ettlie, Perotti, Joseph, and Cotteleer (2005) and Velcu (2010) determined that BPR could directly influence corporate success through increasing performance, and raising internal efficiency. In short, BPR is a powerful instrument that can be used for restructuring non-valued activities, minimizing the complexity of the business processes, and removing wasteful processes.

## 3. Conceptual Framework and Hypothesis Development

The conceptual model shown in Figure 1 proposes to study influences toward the use intention by combining well-accepted elements of TAM (PEOU, PU and IU) with two organizational drivers and externalities (TRA, BPR and GOV).

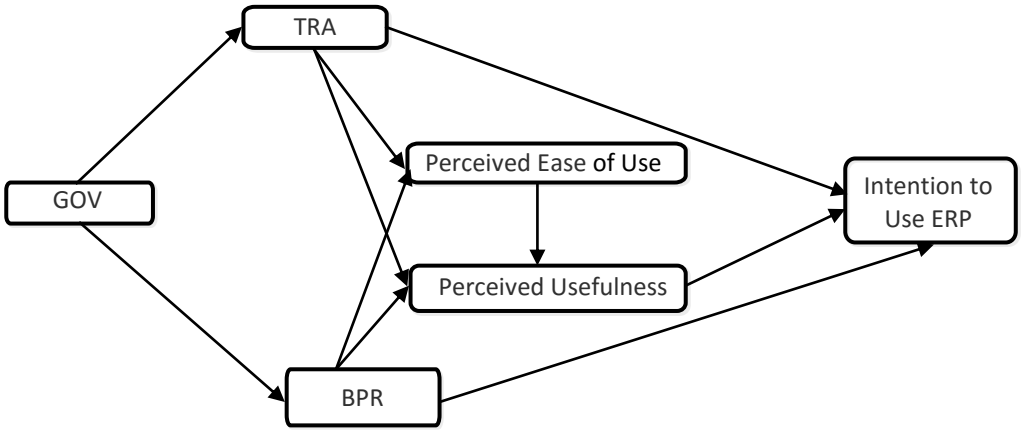



**Figure1**: Conceptual Model (Davis, 1989)

### - Government (GOV) Impact

The role of government is similar to that of management in the business realm. Given this similarity, this research uses GOV to fill the role of top management in the context of ERP success factor. Public administration research by Hu, Liang, Saraf, and Xue (2007) indicates that GOV has a direct relationship to a business facility and use intention for this facility. Research by Wang and Chen (2006) shows that "system training, government support, and organizational support are the significant elements for enabling the use of a personal computer" (p.1033). In economic research, the top management or external supports could encourage all staffs to have a better performance (Bingi, Sharma, & Godla, 1999). In addition, the support could also be indirectly influential to the awareness of a system usefulness (Urbach, Smolnik, & Riempp, 2010). A rural development study by Besley and Burgess (2002) presented two potential governmental support schemes for technology enabling in case of the SME in developing counties. One is business incubation so as to enhance standards, the other is subsidies and tax privileges.

*H1: Increasing government support will have a positive direct effect on Training for the ERP* system.

*H2: Increasing government support will have a positive direct effect on the Business Process Re-engineering for the ERP system.*

### - Training (TRA) Impact

TRA is a key element which allows the adoption and implementation of several applied technological research. The significance of TRA has been highlighted by a number of scholars who found that appropriated training ERP users would give rise to sudden changes in the business operation (Bradford and Florin, 2003, and O'Leary, 2000). In addition, TRA is a simplifying tool for ERP use. Several empirical studies have tested the existence of a relationship between TRA, UI and BI (Bradford and Florin, 2003, O'Leary, 2000, and Ruivo et al., 2014).

*H3: Increasing ERP training will have a positive direct effect on how to conduct the Business Process Re-engineering for using the ERP system.*

*H4: Increasing ERP training will have a positive direct effect on the Perceived Ease of Use of the ERP system.*

*H5: Increasing ERP training will have a positive direct effect on the Perceived Usefulness of the ERP system.*

*H6: Increasing ERP training will have a positive direct effect on the Intention to Use the ERP system.*

**- Impact of Business Process Re-Engineering (BPR)**

A strong integration of the IT and BPR could spontaneously improve an organizational productivity (Johansson, McHugh, Pendlebury, & Wheeler, 1993). IT adoption is used as a crucial element to communicate efficiency within business units, optimize the existing business processes, and minimize the operation cost of the businesses. BPR is not only deployed to re-computerize the business processes, but is an essential reform of the original business processes (Hyeung et al., 2015). An empirical study by Ram and Corkindale (2014) suggests that reshaping an existing business processes can lead to the success of ERP adoption and implementation.

*H7: Conducting Business Process Re-engineering will have a positive direct effect on the Perceived Ease of Use of the ERP system.*

*H8: Conducting Business Process Re-engineering will have a positive direct effect on the Perceived Usefulness of the ERP system.*

*H9: Conducting Business Process Re-engineering will have a positive direct effect on the Intention to Use the ERP system.*

**- TAM Impact**

According to Davis (1989), the original TAM scholar, "there is a strong relationship between PEOU to PU, whist a linkage between PEOU and UI was only implied with theoretical discrepancies" (p.332). PU is theoretically stronger than PEOU in the prediction of UI (Davis, 1989). PU is also found to be an initial influence to measure the cost reduction, revenue creation, transaction efficiency, increased competitiveness, expanded trading scope and error reduction in trading processes in the e-market study from (Holzmüller & Schlüchter, 2002).

*H10: Increasing Perceived Ease of Use will have a positive direct effect on the Perceived Usefulness of the ERP system.*

*H11: Increasing Perceived Usefulness will have a positive direct effect on the Use of the ERP system.*

## 4. Methodology

### *Research Design*

Quantitative measurements along with a cross-sectional study are used as a research method to verify the path connections and predict the UI of ERP for the rice mill industry. The prediction variables comprise GOV, TRA, BPR, PEOU and PU. Those had both a direct and an indirect effect on UI.

### *Sampling*

The research sample were obtained from the lists of two trustful sources; (i) the Agricultural Marketing Co-operative Limited (AMC); an organization under the Bank for Agriculture and Agricultural Cooperatives (BAAC), which includes 1,681 rice mills; and (ii) the Thai Rice Mills Association (TRMA) with 850 rice mill members and 980 rice traders. The TRMA list is seen as more reliable. As a result, the sample consists of rice mills from all parts of Thailand.

In addition, the survey respondents were representatives of the organization who have managerial and decision-making power as their answers must reflect all aspects and direction of each rice mill. Convenience sampling was used as the primary sampling method to capture available respondents of the Thai rice mill sector. Rice mills though are not evenly distributed throughout the country and are instead clustered in some specific areas. Hair, Black, Babin, and Anderson (2010) suggest a minimum of five times the total number of variables.

***Questionnaire***

The completed survey questionnaire (see Appendix 1) was translated into Thai and a pilot test was then conducted with a focus group a 30 rice mills prior to the survey distribution. The survey provided both demographics and attitude measurements. The demographic section included a set of questions on the respondents' personal profile; such as, age, experience and work position, and the rice mill profile (business experience, business generation and location). This section also includes decision questions to verify the level of ERP experience and understanding of each respondent (see Appendix). On attitude measure, all constructs are measured by using a five-point Likert-type scale ranging from (1) "strongly disagree" to (5) "strongly agree'" (see Appendix 2).

Four questions relate to government support. They are a combination of questions from Mcknight et al. (2002), Pavlou (2003), Yuan, Lianxi, Garry, and Weiwen (2009), Nah, Zuckweiler and Lee (2003), Krumbholz and Maiden (2001),and Petroni (2002) respectively. Three TRA questions from Amoako-Gyampah and Salam (2004) and Muscatello, Small and Chen (2003) were slightly changed to suit the ERP context. Three BPR questions come from a combination of questions from Bradford and Florin (2003), Ehie and Madsen (2005), Grover et al. (1995), Hong and Kim (2002),and Hammer and Champy (2009) respectively. Four PEOU questions are based on a combination of questions from Davis (1989) and Venkatesh et al (2003), slightly modified to suit the rice mill industry. Three PU questions are based on Davis (1989) and Venkatesh et al. (2003) and rewritten to suit the rice mill industry. Three UI questions from Davis (1989) and Venkatesh et al. (2003) were adjusted for ERP use of rice mills. Two original BI questions from Davis (1989) and Venkatesh et al. (2003) and adjusted for ERP use of rice mills.

## 4. Data Analysis and Results

A reliability and exploratory analysis (EFA) and confirmatory analysis (CFA) were conducted to ensure that that the data set is refined. For the hypothesis testing, the path analysis and the Structural Equation Modeling (SEM) under the Maximum Likelihood Estimation (MLE) were relied on to establish the covariance structure models. A SEM approach is the most appropriate one for this data analysis because it allows immediate analysis of all relationships and combines together with multiple regressions that demonstrate factor analysis in terms of the statistical fit (Mathieu & Taylor, 2006;Tabachnick, 2007). The SEM is also highly effective to measure errors within observed variables (Gefen, Straub, & Boudreau, 2000;Hair et al, 2010).

All empirical analyses were undertaken within the AMOS and the SPSS software packages. In the analytical procedure, the EFA and the reliability test were conducted in SPSS, and the CFA in AMOS using MLE, which is then followed by the path analysis of the structural relationships (Anderson & Gerbing, 1988). The survey was conducted through 850 samples obtained by telephone interviews. 76% were unreachable and the majority of them were not willing to disclose their details. A total of 205 interviewed respondents were used.

**Table 2**: Demographic Characteristics of Respondents

| Characteristics | Frequency | Percentages (%) |
|---|---|---|
| ***Individual profile*** | | |
| Ages | | |
| Less than 20 year's old | 2 | 1.0 |
| 21-30 year's old | 13 | 6.3 |
| 31-40 year's old | 71 | 34.6 |
| 41-50 year's old | 45 | 22.0 |
| 51-60 year's old | 54 | 26.3 |
| More than 60 year's old | 20 | 9.8 |
| Genders | | |
| Male | 149 | 72.7 |
| Female | 56 | 27.3 |
| Level of Education | | |
| Lower than high school | 8 | 3.9 |
| High School | 37 | 18.0 |
| Vocational | 25 | 12.2 |
| Bachelor degree | 101 | 49.3 |
| Master degree | 33 | 16.1 |
| Doctoral degree | 1 | 0.5 |
| Position | | |
| Business owner | 88 | 42.9 |
| Business heir* | 45 | 22.0 |
| Manager** | 24 | 11.7 |
| Supervisor | 24 | 11.7 |
| Normal staff | 24 | 11.7 |
| Work experience | | |
| less than 1 year | 2 | 1.0 |
| 1-5 years | 22 | 10.7 |
| 5-10 years | 53 | 25.9 |
| 11-20 years | 82 | 40.0 |
| 21-30 years | 20 | 9.8 |
| 31-40 years | 26 | 12.7 |

*Note: *is defined as direct decedent from business owner who currently run the rice mill, ** is defined as manager, who is a non-family member, currently runs the rice mill.*

The survey questionnaires were mostly responded by males. 83% were in the age range of 31-60 years and almost 50% of them had a bachelor degree. In addition, 42.9% are rice mill owners. Most of the rice mills had been in business between 11- 40 years and the average manpower per rice mill was between 10-50 people. The majority of the respondents came from Northern Thailand, and the middle and west regions (28.8%, 26.8% and 23.4% respectively). There is no respondent from the southern region in this data collection. All of rice mills interview had no ERP experience, which implies that all respondents were not capable of BI.

**Table 3**: Rice Mill Profile

| Characteristics | Frequency | Percentages (%) |
|---|---|---|
| ***Rice mill profile*** | | |
| **ERP experience** | | |
| Having ERP experience | 0 | 0 |
| None ERP experience | 205 | 100 |
| **Business generation** | | |
| Establisher | 97 | 47.3 |
| 2nd generation | 78 | 38.0 |
| 3rd generation | 28 | 13.7 |
| 4rd generation | 1 | 0.5 |
| Others | 1 | 0.5 |
| **Manpower** | | |
| Less than 10 | 62 | 30.2 |
| 11-50 | 129 | 62.9 |
| 51-100 | 9 | 4.4 |
| 101-200 | 5 | 2.4 |
| More than 200 | 0 | 0.0 |
| **Business experience** | | |
| Less than 1 year | 8 | 3.9 |
| 1-5 years | 8 | 3.9 |
| 5-10 years | 17 | 8.3 |
| 11-20 years | 66 | 32.2 |
| 21-30 years | 33 | 16.1 |
| 31-40 years | 54 | 26.3 |
| 41-50 years | 19 | 9.3 |
| More than 50 years | 0 | 0.0 |
| **Geographical locations** | | |
| North region | 59 | 28.8 |
| North-Eastern region | 28 | 13.7 |
| Middle region | 55 | 26.8 |
| East region | 15 | 7.3 |
| West region | 48 | 23.4 |
| Total | 205 | 100.0 |

**Validity and Reliability Test**

The Crombec's alphas of all constructs are above 0.7 as shown in Table 4. This means there are all accepted as per the criteria of 0.7 or above (Gravetter & Forzano, 2018;Hair et al, 2010;Nunnally & Bernstein, 1967). The EFA is also performed by using the Maximum-Likelihood function (ML) and the Promax rotation which validate all constructs prior to hypothesis testing. The loading factors used for all measured constructs are accepted under the allowable criteria because all measured constructs (loading factors) are above 0.5 (Chen & Tsai, 2007). The five constructs (GOV, TRA, BPR, PEOU and PU) are properly extracted without any factor interference. As a result, these five prediction variables are well accepted for a prediction of the dependent variable, UI. In addition, the KMO and Bartlett's test also ensure that all measuring samples are significant at a 0.001 level and meet the thresholds of sampling adequacy at 0.782, which is above the allowable criteria of 0.5. This EFA also indicates that those five factors can explain the 55.352 % total variance.

**Table 4**: Construct Validity and Reliability Assessment

| Constructs | Items | EFA (loading) | α |
|---|---|---|---|
| Government support (GOV) | GOV1 | 0.827 | *0.798* |
| | GOV2 | 0.766 | |
| | GOV3 | 0.691 | |
| | GOV4 | 0.622 | |
| Training (TRA) | TRA1 | 0.892 | 0.812 |
| | TRA2 | 0.807 | |
| | TRA3 | 0.506 | |
| Business process re-engineering (BPR) | BPR1 | 0.397 | 0.762 |
| | BPR2 | 0.694 | |
| | BPR3 | 0.917 | |
| Perceived ease of use (PEOU) | PEOU1 | 0.482 | 0.700 |
| | PEOU2 | 0.463 | |
| | PEOU3 | 0.574 | |
| | PEOU4 | 0.596 | |
| Perceived usefulness (PU) | PER1 | 0.553 | 0.716 |
| | PER2 | 0.694 | |
| | PER3 | 0.575 | |
| Use intention (UI) | UI1 | - | 0.772 |
| | UI2 | - | |
| | UI3 | - | |

**Hypothesis Testing**

This empirical research conducted a multiple linear regression analysis using the co-variance structure analysis (Arbuckle & Wothke, 1999). For hypothesis testing, the path analysis with the MLE was established for covariance structure models. As Table 5 indicates, the proposed empirical model has met the fit criteria of several goodness-of-fit indexes. Such criteria include the rules of thumb (Schermelleh-Engel, Moosbrugger, and Müller, 2003). The empirical model presents a number of critical fit-indexes: $X^2$/DF = 2.151; GFI = 0.986; AGFI = 0.925; CFI = 0.987; TLI=0.952; NFI=0.977; RMR = 0.02; RMSEA = 0.075; PCLOSE = 0.221; measuring values are not significant at the 0.072 level; Chi-square = 8.6029, Degree of freedom =4, and probability level=0.0718. According to those fit indexes, the research model satisfies all the goodness-of-fit indexes.

**Table 5**: Model Fit Results

| | ***X²/Df*** | **Significant** | **GFI** | **AGFI** | **RMR** | **CFI** | **TLI** | **NFI** | **RMSEA** | **PCLOSE** |
|---|---|---|---|---|---|---|---|---|---|---|
| Acceptable criteria | < 3 | *p* > .05 | ≥ .95 | ≥ .90 | < .05 | ≥ .90 | ≥ .90 | ≥ .90 | <0.08 | *p* > .05 |
| Research model | *2.151** | *0.072** | *0.986** | *0.925** | *0.02** | *0.987** | *0.952** | *0.977** | *0.075** | *0.221** |

*Note: *value is accepted*

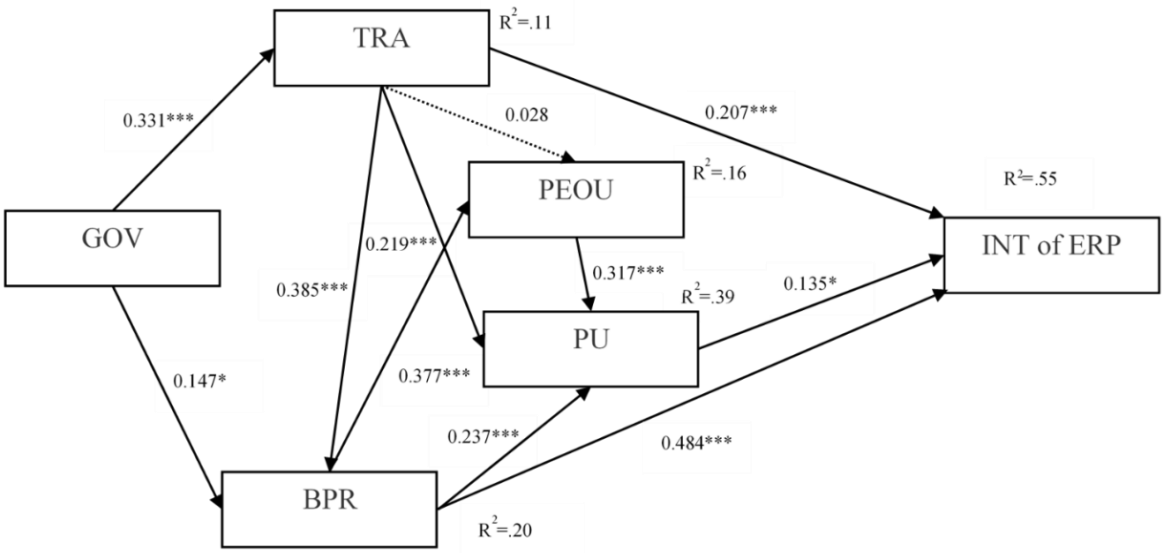
Table 6 summarizes the hypothesis results. Only one hypothesis (H4) is rejected.

**Table 6**: Summary of Hypothesis Development

| | Hypothesis | Expected Effect | β | Sig. | Results |
|---|---|---|---|---|---|
| H1 | *Increasing Government support will have a positive direct effect on Training for the ERP system.* | + | 0.331 | **0.000** | **Accepted** |
| H2 | *Increasing Government support will have a positive direct effect on the Business Process Re-engineering for using the ERP system.* | + | 0.147 | *0.026* | **Accepted** |
| H3 | *Increasing ERP Training will have a positive direct effect on the Business Process Re-engineering for using the ERP system.* | + | 0.385 | **0.000** | **Accepted** |
| H4 | *Increasing ERP Training will have a positive direct effect on the Perceived Ease of Use the ERP system.* | + | 0.028 | 0.683 | Rejected |
| H5 | *Increasing ERP Training will have a positive direct effect on the Perceived Usefulness the ERP system.* | + | 0.219 | **0.000** | **Accepted** |
| H6 | *Increasing ERP Training will have a positive direct effect on the Intention to Use the ERP system.* | + | 0.207 | **0.000** | **Accepted** |
| H7 | *Conducting Business Process Re-engineering will have a positive direct effect on the Perceived Ease of Use of the ERP system.* | + | 0.377 | **0.000** | **Accepted** |
| H8 | *Conducting Business Process Re-engineering will have a positive direct effect on the Perceived Usefulness of the ERP system.* | + | 0.237 | **0.000** | **Accepted** |
| H9 | *Conducting Business Process Re-engineering will have a positive direct effect on the Intention to Use the ERP system.* | + | 0.484 | **0.000** | **Accepted** |
| H10 | *Increasing Perceived Ease of Use will have a positive direct effect on the Perceive Usefulness of the ERP system.* | + | 0.317 | **0.000** | **Accepted** |
| H11 | *Increasing Perceive Usefulness will have a positive direct effect on the Intention to Use the ERP system.* | + | 0.135 | 0.014 | **Accepted** |

Firstly, the relationships between GOV to TRA and BPR are accepted with positive relationships. However, the β and significant level between GOV and TRA (β=0.331, t=0.000) is stronger than the β and significant level between GOV and TRA (β=0.147, t=0.026). Secondly, the relationships between TRA to BPR, PU and UI are accepted with all of them positively related. Only, the relationship between TRA and PEOU is rejected. The relationship between TRA and BPR (β=0.385, t=0.000) is stronger than the relationship between TRA and PU (β=0.219, t=0.000), and the relationship between TRA and IU (β=0.207, t=0.000). Thirdly, the relationships between BPR and PEOU, PU and UI are accepted with all of them positively related with the highest significant level. The relationship between BPR and IU (β=0.487, t=0.000) is stronger than the relationship between BPR and PEOU (β=0.377, t=0.000), and the relationship between BPR and IU (β=0.237, t=0.000). Finally, the relationship between PEOU and the PU (β=0.317, t=0.000) is stronger and higher in the level of significance than the relationship between PU and UI (β=0.135, t=0.014).

Figure 2 presents the path model results. There are five paths with the significant relationships. Those path relationships are explained in terms of the coefficient of determination ($R^2$) accordingly. TRA is explained by 11% ($R^2$=.11) variance of GOV; BPR by 20% ($R^2$=.2) variance of GOV; PEOU by 16% ($R^2$=.16) variance of BPR, PU by 39% ($R^2$=.39) variance of PEOU, PU and BPR. As to IU, it is explained by 55% ($R^2$=.55) variance of TRA, BPR and PU.




Note: $*p \leq 0.05$, $**p \leq 0.01$ and$*** p \leq 0.001$

**Figure 2**: Path Analysis and Model Results

## 5. Discussion and Conclusion

Since all rice mills sampled have never used ERP in their businesses, this study reflects only a dimension of the non-ERP experience users because. This means that the Thai rice mill industry is not yet familiar with ERP. The empirical results clearly present potential influences along with all interrelationships incurred by both external influence and internal adjustments that are capable of encouraging ERP use intention. In terms of external influence, rural development research by Besley and Burgess (2002) suggests that government schemes in developing countries could have a direct effect on technology enabling, provided these schemes are in the form of financial support and business incubations. Besley and Burgess' findings, however, are not consistent with the results in this study, which shows that government support schemes will not directly influence the use of ERP in the agricultural sector. There need to be training and business process re-engineering acting as moderators. But direct government support has a different effect on technology adoption in advanced industries such as the adoption of computers in medical research (Wang and Chen, 2006).

Government schemes could instigate and transform an existing business to be more technologically friendly (Rajan & Baral, 2015). Advanced education and training programs, on the other hand, could be easily pushed by external support, especially in the case of organizations receiving government funds (Urbach et al, 2010;Nwankpa & Roumani, 2014). So ERP training could be highly accepted if supported by significant contribution from the government. Conducting training could possibly lead to ERP adoption. ERP's training could also significantly contribute to the organization restructuring and bring about a perception of ERP's usefulness prior to encouraging ERP adoption. These findings are in-keeping with a number of studies on the key factors to successful ERP adoption (Bingi, Sharma, and Godla, 1999; Somers and Nelson, 2001). These studies suggest that the training program is the key success for ERP adoption. O'Leary (2000) and Bradford and Florin (2003) concluded that appropriate training will result in the re-engineering of business processes toward organizational benefits.

Another critical finding from this empirical study is that there is a direct impact from training on the use intention of ERP. This finding is corroborated by several studies (Muscatello and Chen, 2008); Bradford and Florin, 2003; and Ruivo, Oliveira, and Neto, 2014). As to internal adjustment for this agricultural scenario, the TAM construct proposed by Davis (1989) can be applied as a mediator between the effect of training and business re-engineering through the intention of the ERP adoption. Regarding re-engineering influence, business process re-engineering could generate an intention to use ERP. However, one of the challenges of re-engineering is that the perception of easiness and usefulness in ERP must be encouraged along with an implantation of business re-engineering. For theoretical contribution, our research finding supports other scholars in different work scopes. Hyeung et al (2015) proposed that an organization re-engineering could conveniently accommodate adopting IT investment and Ram and Corkindale (2014) suggested that a better and more suitable business process could provide more chances for success in ERP adoption and implantation.

***Business Implications***

Training and business process re-engineering are key components to change perceptions toward ERP adoption and implantation in agricultural businesses with non-ERP experience. In this study, business re-engineering is more important for rice mills due to the existing work process of this business, especially in rural areas where it is generally primitive and less complex than high standard business corporate patterns. Once, the work process shifts from manual to systematic operations, this change will allow ERP to be easily adopted since ERP is more compatible with a standardized and systematized organization. In addition, internal training requires in parallel to readjust the level of knowledge and maintain personal confidence from a different work process. Changing in business generations could also be critical in terms of change in ERP adoption scenario as under the assumption that younger generations will be more technologically aware, ERP adoption or usage will be possibly higher.

In term of ERP software deployment, the developer and business owners should be in agreement with the basis of the changes in the business process needed to satisfy ERP operations (Gattiker and Goodhue, 2002). The ERP system will potentially enhance the completive advantage of the agricultural business but software developers must work from the non-IT background and customize it to meet the Thai agricultural characteristics. In addition, operating the interphases of ERP must be user friendly and the ERP system must be distinctively functional, especially in term of tangible benefits, such as cost reduction, manpower reduction and real time communication. Finally, an important challenge for agricultural organizations is seemingly to find a best-fit systematical pattern that all enterprises are entirely willing to follow. A consultancy and training from an experienced party are alternatively viable for agricultural enterprises, which are less self-dependable.

***Policy Recommendations***

Government contributions such as financial resources, tax privileges and information support schemes are less likely to enable a direct use of ERP in Thai agricultural businesses (Besley & Burgess, 2002). The most viable opportunity for the effective interference is thus to understand the existing operation and business nature of the agricultural sector. As this study suggests, the support scheme should be grounded on the logical thinking of the non-technical knowledge as all those agricultural enterprises have no ERP background. Hence, appropriate support from the government is recommended in the form of knowledge sharing, consultancy and business incubation to create use awareness and values of the system rather than just in

the form of financial solutions. Until rice mills realize the importance of ERP use and the system usefulness, none of them will adjust their existing business processes to accommodate ERP system. A significant challenge of any government scheme is to create continuous and tangible support that could instigate a change in the business paradigm and make businesses realize the value of ERP. Developing policies, such as enhancing competitive advantages through technological adoption and business readjusting programs for the economy 4.0, are the greatest concerns of the current national propagations and supports. However, these policies must specifically comply with agricultural and rural business behaviors, which are dramatically different from corporate standards.

At the present time, the Thai government has enthusiastically adopted several schemes and projects for technological changes via government agencies and funding in technological co-operation research programs between universities and businesses. But this support structure is relatively limited to big companies and not enough evenly dispersed to include rural opportunities. An existing example of government support is the Division of the Digital Industry Development (DDID), a government agency under the ministry of industry. It offers ERP support through educational programs, in-depth consultancy, and a list of recommended ERP developers to registered SMEs (DDID, 2019). Nevertheless, this support under a national program designed to enhance a firm's competitive advantage through the use of digital tools is very specific to the industrial sector rather than to agricultural businesses.

**Limitations**

There are three main limitations to this study. Firstly, the public data base is not trustworthy and not updated. 76% of the contact lists are unreachable. This affects the precision of the sample size calculation. Secondly, this study is solely subjected to samples with non-experience of ERP, which means that adoption characteristics could be possibly changed with samples having ERP experience. Lastly, the conclusion from the rice mill industry could not strongly generalize the whole population of the agricultural sector. However, time constraints and the size of the agricultural industry caused the random selection of the agricultural samples to be limited.

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**Appendix 1**

Survey Questionnaire: *Success Factors toward Adaptation of Technology for the Enterprise Resource Planning in Thai Agricultural Enterprise: Study of the Thai Rice mill.*
Instructions
Answer questions as they relate to you. For most answers, check the box(es) most applicable to you or fill in the blanks.

About You

*1. Your Age*

- ☐Less than 20 years-old
- ☐21-30 years-old
- ☐31-40 years-old
- ☐41-50 years-old
- ☐51-60 years-old
- ☐More than 60 years-old

*2. Your Gender*

**(Select only one.)**

- ☐Female
- ☐Male

*3. Your Role*

**(Select all that apply.)**

- ☐Rice mill owner
- ☐Rice mill heir
- ☐Rice Executive
- ☐Rice Supervisor
- ☐Other (please in identify: _____)

*4. Your Education*

**(Select all that apply.)**

- ☐Lower than high school
- ☐High School
- ☐Vocational
- ☐Bachelor degree
- ☐Master degree
- ☐Doctoral degree

*5. How long have you been with this rice mill?*

**(Select only one.)**

- ☐less than 1 year
- ☐1-5 years
- ☐5-10 years
- ☐11-20 year
- ☐21-30 year
- ☐31-40 year
- ☐more than 41 years

About Your Rice mill

*6. How many employees are at your rice mill?*

**(Select only one.)**

☐10 or less
☐11-50
☐51-100
☐101-200
☐201-300
☐301-400
☐401-500
☐501 or more

*7. How long does your rice mill established?*

**(Select only one.)**

☐less than 1 year
☐1-5 years
☐5-10 years
☐11-20 years
☐21-30 years
☐31-40 years
☐41-50 years
☐more than 51 years

*8. What is rice mill business generation?*

**(Select only one.)**

☐Establisher
☐2nd generation (Son and Daughter)
☐3rd generation (Grandson and Granddaughter
☐4rd generation (Great-grandson and Great-granddaughter)
☐Other (please in identify: _____)

*9. Please identify your per product (rice milling) capacity per year in (Ton)?*

Please identify in number_____(Tons)

*10. Where is you rice mill location (answer in city name)?*

City name_____

About Usage of Enterprise Resource Planning System

*11. Enterprise Resource Planning Knowledge Check?*

Please select one answer each that is best apply to question, leaving blank is also allow.

(1) ERP Stands for:

☐A) Engaged Research and Planning
☐B) Enterprise Reasoned Plan
☐C) Enterprise Resource Planning
☐D) Effective Resource Planning
☐E) Electronic Research Plan

(2) An ERP system should be capable of:

☐A) Posting and tracking the detailed activities of a business
☐B) Help users make intelligent judgments about how to run a business
☐C) A or B
☐D) A and B
☐E) None of the above

(3) The scope of ERP applications extends to:

☐A) Accounting and finance

☐B) Human resources, sales and marketing, and manufacturing and logistics

☐C) Customer relationship management and cloud computing

☐D) A and B

☐E) All of the above

(4) Cash-to-cash cycle time is equal to:

☐A) Inventory days of supply - Days of sales outstanding + Average payment period for material

☐B) Inventory days of supply + Days of sales outstanding - Average payment period for material

☐C) Inventory days of supply - Days of sales outstanding + Average payment period for material

☐D) Inventory days of supply - Days of sales outstanding - Average payment period for material

(5) Internal supply chain of a manufacturing enterprise consists of all of the following except:

☐A) Procurement cycle

☐B) Marketing cycle

☐C) Sales and distribution cycle

☐D) Manufacturing cycle

*12. What is the Enterprise Resource Planning?*

Please identify in brief (no more than 2 sentences)

_____

_____

*13: Did your rice mill use the Enterprise Resource Planning System in business?*

☐Yes ☐NO

If you answer NO (N) in question 13 please go for section A but If you answer Yes (Y) in question 11 please go for section B.

SECTION A

| About Technology adoption and Enterprise Resource Planning | | | | | |
|---|---|---|---|---|---|
| Statement | (1) Strongly Disagree | (2) Disagree | (3) Neutral | (4) Agree | (5) Strongly Agree |
| 14: PEOU | | | | | |
| 14.1 Feeling ease of use from other rice mills could influence our rice mill decision to use the ERP system or other advance system. | | | | | |
| 14.2 It would be easy for me and team to become skillful at using highly systemic program. | | | | | |
| 14.3 Our rice mill has the sufficient resources necessary to use the ERP system such as PC and internet support. | | | | | |
| 14.4 Learning to operate the advance and systematic software is possibly easy for our rice mill. | | | | | |
| 15: PU | | | | | |
| 15.2 Using standard and highly systematic process could enables our rice mill to accomplish work tasks quickly. | | | | | |
| 15.3 Using the ERP could increase productivity in rice mill operation. | | | | | |
| 15.4 If our rice mill uses the ERP system, there will be more chances of getting a business competitive advantage. | | | | | |
| 19: Use Intention | | | | | |
| 19.1 Our rice mill intends to have rapid use of system like the ERP, once the program is proven efficiently. | | | | | |
| 19.2 I predict that rice mill would use the new enterprise resource planning system in quick time after agreement is made. | | | | | |
| 19.3 Our rice mill plans to use the new system in very soon after having satisfied with the system condition. | | | | | |

| Business Process Re-engineering | | | | | |
|---|---|---|---|---|---|
| Statement | (1) Strongly Disagree | (2) Disagree | (3) Neutral | (4) Agree | (5) Strongly Agree |
| 21: BPR | | | | | |
| 21.1 Our rice mill could allow to spend long time in redesigning business processes before configuring the ERP use. | | | | | |
| 21.2 Our rice mill is willing to standardize the business processes to fit the ERP system or better work system. | | | | | |
| 21.3 Our rice mill will allow to adjust organizational process to accommodate the process built in the ERP. | | | | | |

| Training | | | | | |
|---|---|---|---|---|---|
| Statement | (1) Strongly Disagree | (2) Disagree | (3) Neutral | (4) Agree | (5) Strongly Agree |
| 22: TRA | | | | | |
| 22.1 Training will substantially improve the level of staffs' understanding with the ERP intention | | | | | |
| 22.2 Training give our rice mill staff's confidence in the new ERP system or other advance systems. | | | | | |
| 22.4 Knowledgeable trainer can navigate through the well performing after training and inspire to use the program | | | | | |

| Government support | | | | | |
|---|---|---|---|---|---|
| Statement | (1) Strongly Disagree | (2) Disagree | (3) Neutral | (4) Agree | (5) Strongly Agree |
| 23: GOV | | | | | |
| 23.1 Tax privilege and government incentives could inspire our rice mill to start using the ERP system or program. | | | | | |
| 23.2 Providing information and service of ERP from government will result in attention of ERP use. | | | | | |
| 23.3 Consistency in national support, especially in IT and technology, could affect investment of new system and program in the rice mill. | | | | | |
| 23.4 Supportive government policy could be an importance to uncover the ERP opportunities for the rice mill industry. | | | | | |

SECTION B

| About Technology adoption and Enterprise Resource Planning | | | | | |
|---|---|---|---|---|---|
| Statement | (1) Strongly Disagree | (2) Disagree | (3) Neutral | (4) Agree | (5) Strongly Agree |
| 14: PEOU | | | | | |
| 14.1 Feeling ease of use from other rice mills could influence our rice mill decision to use the ERP system or other advance system. | | | | | |
| 14.2 It would be easy for me and team to become skillful at using highly systemic program. | | | | | |
| 14.3 Our rice mill has the sufficient resources necessary to use the ERP system such as PC and internet support. | | | | | |
| 14.4 Learning to operate the advance and systematic software is possibly easy for our rice mill. | | | | | |
| 15: PU | | | | | |
| 15.2 Using standard and highly systematic process could enables our rice mill to accomplish work tasks quickly. | | | | | |
| 15.3 Using the ERP could increase productivity in rice mill operation. | | | | | |
| 15.4 If our rice mill uses the ERP system, there will be more chances of getting a business competitive advantage. | | | | | |
| 19: Use Intention | | | | | |
| 19.1 Our rice mill intends to have rapid use of system like the ERP, once the program is proven efficiently. | | | | | |
| 19.2 I predict that rice mill would use the new enterprise resource planning system in quick time after agreement is made. | | | | | |
| 19.3 Our rice mill plans to use the new system in very soon after having satisfied with the system condition. | | | | | |
| 20: Behavioral Intention | | | | | |
| 20.1 Our rice mill often uses the system to manage my task | | | | | |
| 20.2 Our rice mill satisfied with my decision to use the system | | | | | |

| Business Process Re-engineering | | | | | |
|---|---|---|---|---|---|
| Statement | (1) Strongly Disagree | (2) Disagree | (3) Neutral | (4) Agree | (5) Strongly Agree |
| 21: BPR | | | | | |
| 21.1 Our rice mill could allow to spend long time in redesigning business processes before configuring the ERP use. | | | | | |
| 21.2 Our rice mill is willing to standardize the business processes to fit the ERP system or better work system. | | | | | |
| 21.3 Our rice mill will allow to adjust organizational process to accommodate the process built in the ERP. | | | | | |
| Training | | | | | |
| Statement | (1) Strongly Disagree | (2) Disagree | (3) Neutral | (4) Agree | (5) Strongly Agree |
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| 22.1 Training will substantially improve the level of staffs' understanding with the ERP intention | | | | | |
| 22.2 Training give our rice mill staff's confidence in the new ERP system or other advance systems. | | | | | |
| 22.4 Knowledgeable trainer can navigate through the well performing after training and inspire to use the program | | | | | |
| Government support | | | | | |
| Statement | (1) Strongly Disagree | (2) Disagree | (3) Neutral | (4) Agree | (5) Strongly Agree |
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