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The Factors That Differentiate High Level and Low Level of Adoption of Problem Solving Tools in Malaysia: A Discriminant Analysis

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Abctract: The adoption level of problem solving tools in manufacturing sector of SMEs could be divided into two groups which is The low level of adoption and high level of adoption. The low level of adoption is the companies that adopt problem solving tools at a very low level such as one department whereas high level of adoption is the companies that adopt the tools at the problem solving processes of most of the departments. This research found out three predictors which is compatibility, organizational resources and government support that differentiate the levels of Adoption. About 1000 questionnaires of this research are sent out to the respondents through post and 281 respondents replied which is having the response rate of 28.1% but in the end only 141 valid for final analysis process. The results are analyze using the discriminant analysis technique using the SPSS Software. The result of the analysis found out that compatibility is found to be the most significant predictors that differentiate the groups in the dependent variable.

Key words: Problem solving tools, problem solving, compatibility, resources, SME, government support

INTRODUCTION

The survival rate of a company is becoming more challenging and decreases in a huge amount if compare with the amount of SMEs 5 year ago. Many companies did not survive the economy change and went bankrupt. The bankruptcy rate is high especially on the Small and Medium Enterprise (SME). SMEs are companies who just started their business or companies who are developing and they are very limited in their companie's resources such as human resources and financial resources. In many countries, SMEs act as an important role in the country's economy growth and also as the backbone of the country's economy for example, SMEs in Malaysia acts as the backbone of the economy of Malaysia as 97.3% of the business in Malaysia are built up by SMEs (SMECORP Malaysia, 2012a b, 2014). Manufacturing sector of the SMEs are playing the most important role in Malaysia's economy as they provide high GDP growth and also acts as an important hub for providing quality products to many large organizations and the end users (Hashim and Osman, 2003; Sahran *et al*., 2010).

However, the bankruptcy level of Manufacturing SMEs in Malaysia is very high. According to SMECORP, the manufacturing sector of the SMEs that bankrupt are at high amount of 1512 from the year 2005 which is 39,737 to 2011 which is 37,861 (Department of Statistics, 2012; SMECORP Malaysia, 2014). This amount is very obvious and one of the reason is because Manufacturing SMEs could not cope with their daily problems in their daily production processes which in the end lower down the quality of their products produced. Daily problems such as employee's working attitude, products defects. and products late productions will lead to more serious problem to the Manufacturing SMEs (Yeoh *et al*., 2009). Hence, problem solving tools are introduced to the manufacturing SMEs to lower their burden in solving the problems and at the same time increase the effectiveness of the problem solving process.

In the market, there are a lot of different kinds of problem solving tools for example, TRIZ, Plan Do Check Act (PDCA), Six Sigma, FMEA and 5 Whys. The tools are custom made to tackle different kinds of problems that encountered by the companies during their daily problem solving processes (Hagemeyer *et al*., 2006; Yeoh *et al*., 2009). For example, TRIZ contains 40 inventive principles which counter different problems in different scenario. PDCA on the other hand contains four phase which could provide an effective approach for problem solving processes and it is said that the quality of the products produced will increase by one level once the four phases are fulfilled (Ning *et al*., 2010; Zhichun and Yuejun, 2011).

However, due to the resources constraints of the SMEs such as human resources and financial resources, the adoption level of problem solving tools is very

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low and not successful adopted in most of the problem solving processes of the companies (Hashim and Osman, 2003; Yusof, 2003; Ross, 1999; Sahran *et al*., 2010).

Hence, this research will discuss about the factors that affects the adoption level of problem solving tools in manufacturing sector of SMEs in Malaysia using the technology, organization and external environmental framework.

Technology, Organization and External environmental (TOE) framework: In this research, the research framework which is developed by Tornatzky *et al.* (1990) is used. The framework is called the Technology, Organization and External Environmental (TOE). It is one of the widely used framework for investigating and identify the factors which influence the adoption and implementation of new technologies and innovations in the context of the organizations level (Marimuthu *et al*., 2011; Oliveira and Martins, 2011). The TOE model contains three main factors which is the technological factors, organizational factors and external environmental factors.

The technological factors discuss about the external and internal technologies related to the company when adopting new technologies and innovations (Oliveira and Martins, 2011; Starbuck, 1976; Tornatzky *et al*., 1990). Basically the decision of the adoption of new technologies lies on the availability of the technologies and also how the technologies could fit in the companie's current technologies as companies may have different technologies hence not all the new technologies and innovations are successfully adopted (Tornatzky *et al*., 1990).

On the other hand, Organizational factors discuss about the firm size, formalization and amount of resources to adopt the new technologies. According to past researches, one of the most important factors in Organizational factors is availability of extra resources. It could be divided into two groups which are extra financial resources and extra human resources (Tornatzky *et al*., 1990).

Lastly is the external environmental factors of the TOE model which is discussing about the field and platform where the companies are conducting their business (Tornatzky *et al*., 1990). Some of the factors in the external environmental factors are the industry, competitors, supplies, customers, government and dealers (Marimuthu *et al*., 2011; Oliveira and Martins, 2011; Ungan, 2004). The industry partners, customers and suppliers are the most important contributors to the adoption of the new technologies and innovations. According to Bartel and Lichtenberg (1987), the new technologies requires extra knowledge and it could be a burden to the companies. Hence, supplier and industry partners who willing to help in the trainings and after sales support will help to lift the burden of the company and increases the adoption level of the new technologies and innovations.

Technological factor

Compatibility: Compatibility is whether the new technologies is suitable for the company's needs and structure (Alam, 2009; Beatty *et al*., 2001; Rogers, 2003; Ungan, 2004; Zhu *et al*., 2006). It is also said in many researches that compatibility is a key factor of the adoption of new technologies (Cooper and Zmud, 1990; Marimuthu *et al*., 2011; Ungan, 2004; Zhu *et al*., 2006). For example, according to Ungan (2004), one of the key issue to check when adopting new technologies is to check whether the technologies are suitable to the companie's existing technologies and processes.

In the context of this research, the Problem Solving Tools must be able to adapt into the daily problem solving processes of the companies and will not affect other processes of the company:

- H_1: Compatibility is a good predictor of the adoption level of problem solving tools in manufacturing sector of SMEs in Malaysia

Organizational factor

Organizational resources: Organizational resources is one of the important factors that influence the adoption level of new technologies and innovations and could be categorized into financial resources and human resources (Chau and Tam, 2000; Franco and Haase, 2010; Jusoh and Parnell, 2008; Tornatzky *et al*., 1990; Ungan, 2004). Kwon and Zmud (1987) and Ungan (2004) mentioned in their researches that if the companies are having more extra resources, then the probabilities of the companies to adopt the new technologies will increase.

In this research, one of the reason why SMEs did not adopt problem solving tools in a higher level is because lacking of resources such as money for trainings and also expertise to use the tools and help the departments to adopt the tools:

- H_2: Organizational Resources is a good predictor of the adoption level of problem solving tools in manufacturing sector of SMEs in Malaysia

External environmental factor

Government support: The government is also another party that play an important role in the success of SMEs

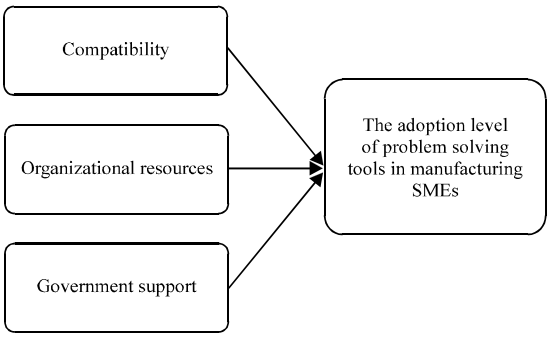

Fig. 1: Research framework

in any country. The government act as a helping hand for SMEs in providing trainings and financial aid to SMEs which are growing (Kendall *et al*., 2001; Marimuthu *et al*., 2011; Tan and Toe, 2000). In most countries, SMEs acts as the backbone of the economy of the country for example Malaysia SMEs cover 97.3% of the business of the country (Department of Statistics, 2012; SMECORP Malaysia, 2014).

In Malaysia also government such as SMECORP and SIRIM provides a lot trainings and financial aid for SMEs who wish to adopt problem solving tools (SMECORP Malaysia, 2012a, b). Hence, the higher the companies receive help and assist from the government, then the higher the adoption level of the problem solving tools:

- H_3: Government support is a good predictor of the adoption level of problem solving tools in Manufacturing Sector of SMEs in Malaysia Fig. 1

MATERIALS AND METHODS

The research was conducted with a random sampling technique where it is carry out from a list of Manufacturing Sector SMEs are retrieved from reliable sources such as SMEINFO and SMECORP (SMECORP Malaysia, 2011, 2012a). After getting the list of SMEs, the respondents are chosen randomly using a software. Total 1000 respondents are chosen from the list.

All questionnaires are sent to the respondents by postage service and only targeted to the skill workers or the managerial positions of the companies as they are the decision makers for adopting problem solving tools in their companies.

After the data collection period of 4 months had ended, a total of 281 questionnaires came back with the response rate of 28.1% and 141 questionnaires are suitable for data analysis which fulfils the requirement of the rule of thumb by Hair *et al*. (2013) where ten cases or respondents per predictor. After that, SPSS is used to analyse the results.

RESULTS AND DISCUSSION

The SPSS software was used to conduct the analysis after the data collection stage. This research will conduct discriminant analysis techniques on the data collected. It is a technique to analyse the relationships between categorical dependent variable and non-categorical independent variables (Burns and Burns, 2009; Hair *et al*., 2013; Sekaran, 2009). In this research, the independent variables or predictors could differentiate the two level of adoption of problem solving tools which is high level and low level (Field, 2009; Pallant, 2005).

Firstly, the ratio of the cases is tested. This is the first important step as it suggest that whether this model is suitable for discriminant analysis. According to Burns and Burns (2009), the ratio should be in the ratio of five to one. There are 141 cases as shown in Table 1 and having three predictors hence the ratio is 47 which is >5 hence, it is said that this research is suitable to use discriminant analysis.

Next, Table 2 shows the group statistics table where '1' represents the low level of adoption of problem solving tools and '2' represents high level of adoption of problem solving tools. Table 2 shows that the mean values of the two groups are showing a significant difference, hence it is successfully discriminating between two groups (Burns and Burns, 2009).

Table 3 on the other hand shows the significance level of the predictor and the dependent variables. All the significance level of the predictors are <0.05, hence it is said that all predictors are very successful predictors that differentiate the levels of adoption of problem solving tools in manufacturing sector of SME in Malaysia.

While on the other hand, Table 4 shows the Wilk's Lambda table. In this table, the function seen is only one as according to Burns and Burns (2009), the number of discriminant function is the number of groups in the dependent variable -1. The only function here mentioned that the Wilk's Lambda value is 0.845 and with the significant value of 0.00, hence it is said that the research is significant.

The next step of the analysis is on the prior probability table. As mentioned by Burns and Burns (2009), the hit ratio of cross-validated classification accuracy must be 25% larger than the proportional accuracy rate due to chance. Habil (2012) mentioned that there is a formulae to calculate the proportional by chance accuracy rate which is as Table 5 and 6.

Table 1: Analysis case processing summary table

Unweighted cases	Variables	N	Percent
Valid		141	100
Excluded	Missing or out-of-range group codes	0	0
	At least one missing discriminating variable	0	0
	Both missing or out-of-range group codes and at least one missing discriminating variable	0	0
	Total	0	0
Total		141	100

Table 2: Group statistics table

newd	Mean
1.00	
M_COM	4.5789
M_OR	3.7660
M_GS	3.2400
2.00	
M_COM	5.3794
M_OR	4.7024
M_GS	4.0488
Total	
M_COM	4.8117
M_OR	4.0383
M_GS	3.4752

Table 3: Tests of equality of group means table

Variables	Wilk's Lambda	F-values	Sig.
M_COM	0.881	18.691	0.000
M_OR	0.887	17.706	0.000
M_GS	0.942	8.566	0.004

Table 4: Wilk's lambda table

Test of function(s)	Wilk's Lambda	Sig.
1	0.845	0.000

Table 5: Prior probabilities for groups

		Cases used in analysis	
newd	Prior	Unweighted	Weighted
1.00	0.709	100	100
2.00	0.291	41	41
Total	1.000	141	141

Table 6: Classification results

		Predicted group membership		
Variables	newd	1.00	2.00	Total
Original (count)	1.00	96.0	4.0	100
	2.00	28.0	13.0	41
Percentage	1.00	96.0	4.0	100
	2.00	68.3	31.7	100
Cross-validated[a] (count)	1.00	93	7	100
	2.00	30	11	41
Percentage	1.00	93.0	7.0	100
	2.00	73.2	26.2	100

Cross validation is done only for those cases in the analysis. In cross validation, each case is classified by the functions derived from all cases other than that case; 77.3% of original grouped cases correctly classified; 73.8% of cross-validated grouped cases correctly classified

$$(0.709)2+(0.291)2 = 0.503+0.085 = 0.588\times100 = 58.8\%\times1.25 = 73.4\%$$

The final step is to examine the classification results Table. In this Table 6, the cross-validated accuracy rate is 73.8%, hence it is larger than the proportional by chance accuracy rate which was calculated earlier at 73.4%. Finally, we can conclude that the criteria for classification accuracy is fulfilled.

The dependent variable of this research is divided into two groups which is the low level and high level of adoption of problem solving tools. Three predictor variables are also chosen to differentiate the dependent variable. The three predictors are compatibility, organizational resources and government support. The three predictors are chosen from the TOE framework. The discriminant analysis is carried out and found out that the predictors are discriminating the dependent variable successfully with the strongest predictor to be the compatibility.

Compatibility was found to be the most significant predictor which differentiate the two levels of adoption of problem solving tools in manufacturing sector of SMEs in Malaysia. It is having the highest F-value of 18.691. This result is the same as other researches which stated that compatibility is a significant variable for example researches of Beatty *et al.* (2001), Marimuthu *et al.* (2011), Sultan and Chan (2000). Also in the results, we can observe that mean value of companies with high level of adoption of problem solving tools which is 5.3794 is higher than the companies with low level of adoption of problem solving tools which is 4.5789. This is because companies with high level of adoption assume that problem solving tools is more compatible with their daily procedures of problem solving and could be used to solve problems more effectively than the companies with low level of adoption.

Organizational resources is the second most significant predictor of the research as it is having F-value of 17.706. The results is the same as researches done by Chau and Tam (2000), Kenneth *et al.* (2012), Thia *et al.* (2005) and Ungan (2004). The differences in mean values of organizational resources also found out that companies with high level of adoption of problem solving tools have more resources such as human power and financial resources to help them adopt the tools in their daily problem solving processes than the companies which adopt the problem solving tools at low level.

Finally, government support also produces a significant result in this research. Companies with high level of adoption are adopting the tools at a more successful rate because they are getting more support from the government and they realise the benefits of the government support whereas companies with low level of adoption is lesser because they did not know about the government's programme.

CONCLUSION

The main purpose of this research is to look for predictors that differentiate the high level of adoption and low level of adoption of problem solving tools in manufacturing sectors of SMEs in Malaysia. The contribution of this research will help the SMEs who wish to adopt problem solving tools to look for the factors that differentiate the levels of adoption and the reasons why many SMEs are using problem solving tools at a low level. This research also suggest the SMEs that compatibility is the most significant predictors that SMEs should focus on as they need to find the most suitable problem solving tools that suitable for their company. SMEs also should understand their resources and allocate enough resources for their adoption period and also try to understand the help given by the government organizations such as SIRIM and SMECORP.

The research also brought benefits to the board of knowledge by contributing the analysis of using discriminant analysis technique in the relationship between predictors and dependent variables. The research also enhance the TOE framework by using the context of manufacturing sectors of SMEs in Malaysia.

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