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Critical Success Factor of Advanced Manufacturing Technology Implementation on Small Medium Enterprise in Indonesia

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ABSTRACT

The study discusses the factors which influence the implementation of advanced manufacturing technology (AMT) on small medium enterprises (SMEs) of food, beverage and herb which located in Indonesia. It was also discusses on the effect of the implementation of AMT on the SMEs performance. The respondents of this research are the owner of the enterpries. Tests and analysis of the research model were performed using SmartPLS program. The research result shows that the characteristics of the organization, monitoring, and strategic alliances affect the implementation of AMT, and also the implementation of the AMT affects the SMEs performance.

Keywords: Advanced Manufacturing Technology, Small Medium Enterprise, Indonesia
JEL Classifications: L25, L60, N65

1. INTRODUCTION

Studies related to the implementation of advanced manufacturing technology (AMT) in small medium enterprises (SMEs) have been done before. One of the studies that have been done is to determine the relationship and the model AMT implementation strategy for improving the performance of SMEs. This research conducted to produce a theoretical framework and some hypothesis that there is a relationship between the implementation of AMT on the performance of SMEs. In the study it was also mentioned that there are several factors that affect the implementation of the AMT.

These factors are the technological characteristics, critical success factors, strategic alliances and monitoring (Jonsson, 2000). These factors are derived from the literature review from book and journal studies relating to the implementation of AMT and also the company's performance. The results of previous studies only a theoretical framework, so further research is needed to determine the real situation of SMEs that have implemented AMT.

This research was conducted from the standpoint of the owners of SMEs, in particular types of SMEs engaged in food, drinks and herbs contained in the city of Surabaya. Food, beverage, and herbs industry in Indonesia is not only done by the already large enterprises, but also committed to the small and medium scale industries and market share that have been to the level of exports as well as to widen its market share to Indonesia (GAPMMI, 2014). The available data indicate that the number of large enterprises engaged in food and beverage only 0.5% compared to SMEs. But this figure is not directly proportional to the ability of competitiveness, where the ability to compete majority of SME food and drink to the great efforts and imported products is very low. Food and beverage industry problems experienced by the herbal industry.

The problems faced by the SMEs are tighty of the competition in the era of globalization. SMEs still can not compete in terms of quality, cost and delivery (Ministry of Industry of the Republic of Indonesia, 2013). Research conducted by Rahardjo et al. (2015) became a reference in this study. This study focuses on SMEs that have implemented AMT. This is so that it can be seen whether there is a significant relationship between the implementation of the AMT with the performance of SMEs after implementation. The study also focuses on the relationship between the factors that affect the implementation of AMT. This is so that it can be seen any critical success factor which significantly affect the implementation of AMT.

2. AMT

AMT is an integrated manufacturing system for managing people, machines and tools to plan and control the process of producing plant. AMT is also set in terms of purchasing raw materials to product delivery and customer service. Jonsson (2000) states that the AMT is the term used to describe the variation technologies using a computer to control or monitor the manufacturing process.

Research conducted by Rahardjo et al. (2015) concerning model AMT implementation strategies for improving performance of SMEs name a few of the variables that affect the implementation of the AMT. These variables are the characteristics of the organization (company), strategic alliances of the organization and monitoring.

3. RELATIONSHIP AMONG VARIABLES

3.1. Impact of AMT Implementation to Company Performance

As organizations continue to struggle with AMT implementation, the fields of operation management and organization studies have witnessed a boom in the related research. Some existing literature explores various performances in the fields of implementation practices, such as lead time, quality, cost, efficiency, and productivity (Rahman and Bennett, 2009), forecasting, production planning and production administration (Esteves, 2009), level of AMT investments (Monge et al., 2006). Furthermore, Baldwin and Sabourin (2002) remarked that the adoption of Advanced Technologies is associated with the greater growth in labor productivity and market share. The firms that use AMT in advance experience higher growth in market share and productivity. Raymond and Croteau (2005), Koc and Bozdag (2009), Boyer and Pagge (2005) posited that, the AMT implementation affects the improvement of the company's performance. However, Cagliano and Spina (2000) revealed that those effects only apply to limited performances, such as, the use of robotic in the products assembly and only in reducing the manufacturing lead time.

3.2. Relationship between Organizational Characteristics and AMT Implementation

Many reasons to consider the relationship between technology implementation and organizational practices. For example, the relationship between technology and organizational practices has been explored in a good deal of research under various settings, like organizational structure (Ghani and Jayabalan, 2000), practices (Challis et al., 2005), size (Gupta and Whitehouse, 2001) and operation context (Sohal et al., 1992). Ghani and Jayabalan (2000) stated that low productivity after several years of AMT implementation was due to organizational structure that remains mechanistic and not compatible with new technology implementation. Challis et al. (2005) investigated the relationship between AMT implementation with organizational practices in terms of planning, team structure, and human resource management. The results were that these practices were significantly associated with all three integrated manufacturing (AMT, total quality management, and just-in-time) facets. Further, Gupta and Whitehouse (2001) concluded that smaller firms get better performance from technology implementation. This conclusion indicates that firm size is correlated with AMT strategy. Meanwhile, Sohal et al. (1992) highlighted the relationship of AMT implementation with organizational context. They found out that the operational context variable did not have any direct effects on the process of AMT adoption. This condition also occurred when it served as a surrogating variable.

3.3. Effect of Strategic Alliances to the AMT Implementation

Business environment is increasingly characterized by dynamic collaborations in regard to the provision in emerging markets including technology. Since the installation of AMTs need high capital investment and high degree of uncertainty involved in the investments, collaboration with appropriate partners and selection of suitable suppliers may minimize the risk. Burgess (1998) found that buyers seek more a collaborative relationship with their supplier mainly in soft technology implementation. Fulton and Hon (2010) confirmed that the involvement of all stakeholders influences AMT implementation. Furthermore, Rahman (2008) denoted that Buyer-Supplier Relationship (BSR) represents one of the most important attributes of AMT acquisition. Similarly, indicating the importance of collaboration, Ming et al. (2008) revealed that effective collaboration among customers, developers, supplier and manufactures throughout the entire product lifecycle is getting a profound importance to achieve competitiveness. Likewise, Sohal et al. (2006) concluded the progress of AMT is dependent upon the transfer of AMT ideas among the networks of firms, suppliers, industry associations and government.

3.4. Effect of Monitoring to the Success of AMT Implementation

Complexity of AMT in term of technoware, humanware, infoware and orgaware requires certain types of employees during the installation process, thus it is crucial to monitor employees hired during each phase. Chung (1996) found that the employment of more capable workers in skill, knowledge and attitude was statistically significant during the installation phase, but not during the start-up phase. This indicates that worker capability is particularly important when the new technology is initially functioning. When qualified workers are not hired during the installation period, the success of the overall implementation may then be jeopardized. Conversely, if qualified workers are hired only during the start-up period, the success of the implementation will not be affected. This way, the enhanced skills, knowledge, and attitude of the more capable workers are optimally utilized during the installation phase then they can be reassigned to other new projects as the start-up phase progresses. The finding of Marri et al. (2007) confirmed the necessity to control type of workers at the earliest stages of AMT planning and implementation to assure peak performance of a totally integrated system. Based on the empirical findings above, the following hypothesis is then formulated.

4. RESEARCH METHODS

4.1. Structural Equation Modeling (SEM)

SEM is a statistical technique that analyzes the pattern of relationship between latent constructs and indicators, latent constructs with one another, as well as measurement error directly.

SEM allows the analysis of multiple dependent and independent variables directly (Hair et al., 2006). The variables was used in SEM is a latent variable, manifest variables/indicators, and variable error. Latent variables are variables that require a variable number of manifest or latent variable indicators that can be measured. Manifest or indicator variable is a variable that is used to describe/measure latent variables (Santoso, 2014).

4.2. Selection of Respondents

The responden oh this researh are SMEs owner in industry sector of food, beverages and herbs that already implemented the AMT. Type of ownership of SMEs is divided into individual, family, other people, and the combined bank and its subsidiaries. The results showed that the type of ownership of the respondents only individuals and families. Proprietorship amounted to 65%, or about 41 respondents. Type of family ownership amounted to 35% or 22 respondents. The number of SMEs that have 50-500 million of assets is 89% or 56 respondents. SMEs with assets of >500 million is 11%. Base on employees, 28% or 18 SMEs have 5-19, 48% of SMEs have 20-99 and 24% of SMEs have more than 99. Based on the long-established, showed that majority of respondents had stood between 5 and 10 years (41% or 26 SMEs), 25% have stood ≤5 years, and 18% have stood 10-15 years, and only 16% that stood more than 15 years.

4.3. Convergen Validity Test

Convergen validity test conducted with respect to the value of the loading factor that must be >0.5. Values higher loading factor indicates the stronger or invalid data have been generated (Hair et al., 2006).

Loading indicator has a score of <0.5 should be ignored because they were invalid (can not represent the relationship between indicators and variables). While in Figure 1 shows the loading factor value generated by each indicator. Indicators that have a value smaller (<) of 0.5 will be removed from the model baseline. Indicators that have a value <0.5 is (−0.031), of (0.216), inform (−0.187), trust (0.486) and finance (0.149).

4.4. Discriminant Validity Test

Discriminant validity test is done by taking into account the value average varianced extracted (AVE).

Figure 1: Loading factor of each indicator and path coefficient between variables

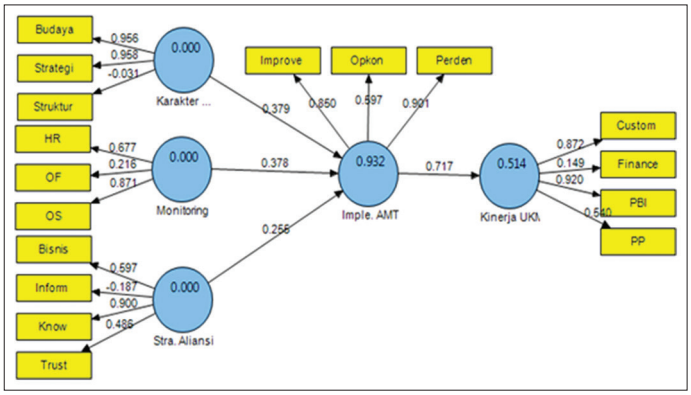


Table 1 indicating the value of each variable AVE. AVE value of a variable must be >0.5 (Ghozali, 2008). According to the Table 2 all grades AVE variables >0.5. Validity discriminat test based on AVE value showed that all variable has discriminant validity.

4.5. Composite Reliability Testing

Reliability testing research model can be known through the value of composite reliability. Variables are said to fulfill composite reliability reliability if the value obtained is >0.7.

This demonstrates the accuracy, consistency, and determination of a measuring instrument to perform a measurement (Ananda, 2015). Table 1 also shows the value of each variable composite reliability. According to the Table 1 in mind that each variable has a value above 0.7 composite variable (>0.7) with variable composite highest value is 0.9567 which is the variable characteristics of the organization. Table 1 indicate that all variables in the model of the research is to be reliable.

5. DATA ANALYSIS

5.1. Analysis of the Structural Model

Analysis model of research done by the application SmartPLS. SmartPLS useful to describe the influence or relationship between the indicator variables and the other variables. Tests using SmartPLS will go through three stages, namely the outer analysis models, analysis models and analyzes inner hypothesis (Ananda, 2015).

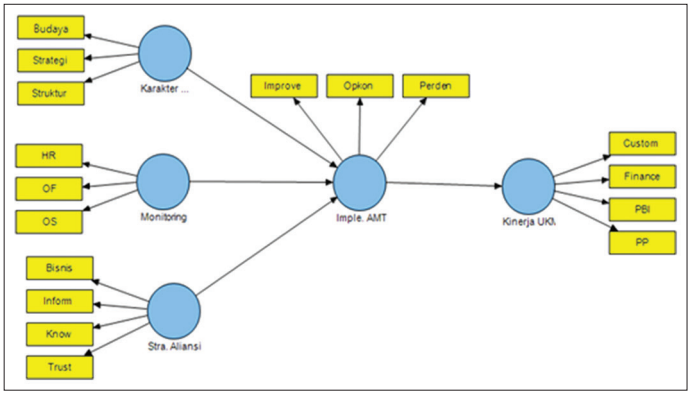
Figure 2 shows a model of the initial research model. The variable characteristics of the organization has a cultural indicator, strategy and organizational structure. Indicators for monitoring variable is the HR (human resource), OS (organization support) and OF (organization facility). Indicators for the variable of the strategic

Table 1: AVE and composite realiability value

Variable	AVE	Composite reliability
AMT implementation	0.6296	0.8323
Organization characteristic	0.9172	0.9567
SME performance	0.6333	0.8317
Monitoring	0.6114	0.7556
Strategic alliances	0.6339	0.7729

AVE: Average variance extracted, AMT: Advanced manufacturing technology, SMEs: Small medium enterprises

Figure 2: The initial of the research model



alliaces are a business alliance strategy, information, know and trust. Indicators in AMT implementation is improvement, OpKon (operation and control) and PerDen (planning and design). Performance indicators for the variable SMEs are finance, customer, PBI (internal business process) and PP (learning and growth).

5.2. Analysis of Outer Model

Analysis of outer model is used to ensure that the measurements made are valid and reliable. Test the validity of the model is done in two ways, namely by convergen validity and discriminant validity test. Convergen validity test known with regard to the value loading factor, while discriminant validity test of the value AVE (average variance extracted) and the value of cross loading. Reliability test models done by considering the value of composite reliability.

5.3. Inner Model Analysis

Inner structural model tosee the percentage of variance explained by looking R^2 dan predictive relevamce (Q^2).

Table 2 shows the R^2 value of the variable AMT implementation and performance of SMEs. R^2 shows the extent to which a variable can be explained by a research or a model (Ananda, 2015). R^2 results can be seen in rated R^2 for the implementation of AMT obtained at 0.9358, this means that the AMT implementation can be explained the characteristics of the organization, monitoring and strategic alliances at 93.58%. Niai R^2 on SME performance variable is equal to 0.5168, this means that SMEs can dijelaskn performance of 51.68% by the variable implementation of AMT. Predictive relevance (Q2) showed how well the observed values indicated by the model. It also shows that the value of the variable redundancy AMT implementation and performance of SMEs is >0, i.e., 0.3567 and 0.3169. It is indicate that the model generated in research fit to the data.

5.4. Hypothesis Testing and Analysis

Hypothesis testing is done by first testing the validity and reliabilities research model. Hypothesis testing is done by comparing the t-statistic model obtained by the t-statistic theory, namely 1.96 with 5% alpha. The hypothesis would be acceptable if the value of t-statistic larger models of the t-statistic theory, namely (t-statistic > 1.96).

Figure 3 shows a new research model after passing through the analysis stage outer inert models and analysis models. The new model is obtained after eliminating some of the indicators that are not valid and reliable in the initial research model.

The initial hypothesis (H):

H_1: Implementation AMT significant impact on the company's performance.

H_2: Organizational characteristics have a significant impact on the implementation of AMT.

H_3: Monitoring significantly affect the implementation of the AMT.

H_4: The strategic alliance significantly affect the implementation of the AMT.

Significance of the causal relationship can be found from Table 3. The first hypothesis is the implementation AMT significant impact on the performance of SMEs. It shown that the value of t-statistic is 10.36 and >1.96. This is in line with previous researches by Burcher et al. (1999) and Thomas et al. (2007). Implementation of AMT business unit (enterprise and SMEs) will bring important tangible and intangible benefits. The benefits are the improved quality, improved corporate image, a process of reduction and improvement of the working environment.

A second hypothesis is the organizational characteristics significant impact on the implementation of AMT. It shows that the value of t-statistic variable correlation characteristics of the organization and implementation of the AMT is equal to 4.80 and >1.96 (4.80 > 1.96). The value of t-statistics show that the second hypothesis is acceptable, ie organizational characteristics significantly influence the AMT implementation. The second hypothesis research results in line with previous researches that says the organization's characteristics affect the implementation of AMT that conducted by Ghani (2000) and Thomas et al. (2007).

The third hypothesis is monitoring a significant impact on the implementation of AMT. The value of t-statistic monitoring and

Table 2: Value of R^2 dan redundancy

Variable	R^2	Redundancy
AMT implementation	0.9358	0.3567
Organisaton characteristic	-	-
SME performance	0.5168	0.3193
Monitoring	-	-
Strategic alliances	-	-

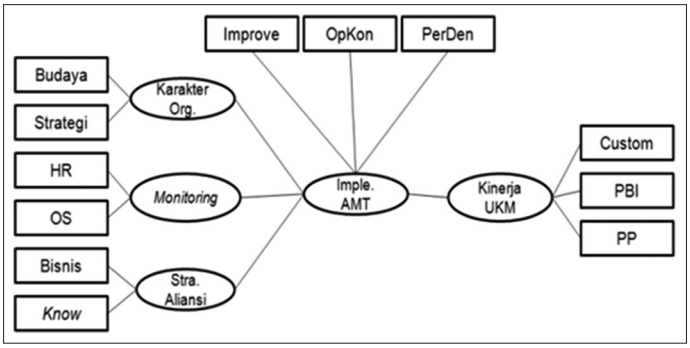
AMT: Advanced manufacturing technology, SMEs: Small medium enterprises

Table 3: Path coefficient among variables

Causal relathionsip between variables	Path coefficient	t-statistics
AMT Implementation→Performance of SMEs	0.717	10.36
Orgnization Charateristic→AMT Implementation	0.790	4.80
Monitoring→AMT Implementation	0.378	4.50
Strategic Alliances→AMT Implementation	0.256	3.75

AMT: Advanced manufacturing technology, SMEs: Small medium enterprises

Figure 3: Research model



implementation of variable correlation of 4.50 and >1.96. It maked the third hypothesis can be accepted. This study was consistent with previous studies conducted conducted by Thomas et al. (2007) and Sohal et al. (2006). Last, the fourth hypothesis is a strategic alliance significantly influence the implementation of AMT. The value of t-statistic monitoring and implementation of variable correlation of 3.75 and >1.96. It maked that the fourth hypothesis can be accepted and consistent with previous studies conducted by Sohal et al. (2006) and Ghani (2000).

6. CONCLUSION

The results of this study indicate that the implementation of AMT in particular SMEs in the business of food, baverages and herbs have a significant impact on company performance. It can be seen from the results were obtained in this study. In addition, this study also shows that there are factors that affect the implementation of AMT that is characteristic of the organization, monitoring and strategic alliances. These three factors significantly influence the implementation of AMT.

REFERENCES

Ananda, H. (2015), Penelitian Bisnis dan Manajemen Menggunakan Partial Least Square (PLS) 3.0. Indonesia: Universitas Brawijaya, Malang.

Baldwin, J.R., Sabourin, D. (2002), Advanced technology use and firm performance in Canadian manufacturing. Journal of Industrial and Corporate Change, 11(4), 761-789.

Boyer, K.K., Pagell, M. (2000), Measurement issues in empirical research: improving measures operation strategy and advanced manufacturing technology. Journal of Operation Management, 18, 361-374.

Burcher, P., Lee, G., Sohal, A. (1999), Lessons for implementing AMT: Some case experiences with CNC in Australia, Britain and Canada. International Journal of Operations and Production Management, 19(5-6), 515-527.

Burgess, T. (1998), Buyer-supplier relationships in firms adopting advanced manufacturing technology: An empirical analysis of the implementation of hard and soft technologies. Journal of Engineering and Technology Management, 15(2), 127-152.

Burgess, T. (1998), Buyer-supplier relationships in firms adopting advanced manufacturing technology: An empirical analysis of the implementation of hard and soft technologies. Journal of Engineering and Technology Management, 15(2), 127-152.

Cagliano, R., Spina, G. (2000), Advanced manufacturing technologies and strategically flexible production. Journal of Operations Management, 18(2), 169-190.

Challis, D., Samson, D., Lawson, B. (2005), Impact of technological, organizational and human resource investments on employee and manufacturing performance: Australian and New Zealand evidence. International Journal of Production Research, 43(1), 81-107.

Chung, C. (1996), Human issues influencing the successful implementation of advanced manufacturing technology. Journal of Engineering and Technology Management, 13(3), 283-299.

Esteves, J. (2009), A benefits realization road-map framework for ERP usage in small and medium-sized enterprises. Journal of Enterprise Information Management, 22(1-2), 25-35.

Fulton, M., Hon, B. (2010), Managing advanced manufacturing technology (AMT) implementation in manufacturing SME. International Journal of Productivity and Performance Management, 59(4), 351-371.

GAPMMI. (2014), Industri Makanan dan Minuman Masih Menghadapi Sejumlah Tantangan. Available from: http://www.gapmmi.or.id/?pilih=lihat&id=25542.

Ghani, K. (2000), Advanced manufacturing technology and planned organizational change. The Journal of High Technology Management Research, 11(1), 1-18.

Ghani, K., Jayabalan, V. (2000). Advanced manufacturing technology and planned organizational change. The Journal of High Technology Management Research, 11(1), 1-18.

Ghozali, I. (2008), Structural Equation Modeling Metode Alternatif Dengan Partial Least Square (PLS). Indonesia: Badan Penerbit Universitas Diponegoro, Semarang.

Gupta, A., Whitehouse, F.R. (2001), Firms using advanced manu-facturing technology management: An empirical analysis based on size. Integrated Manufacturing Systems, 12(5), 346-350.

Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E., Tatham, R.L. (2006), Multivariate Data Analysis. 6th ed. New Jersey: Prentice Hall.

Jonsson, P. (2000), An empirical taxonomy of advanced manufacturing technology. International Journal of Operations and Production Management, 20(12), 1446-1474.

Koc, T., Bozdag, E. (2009), The impact of AMT practices on firm performance in manufacturing SME. Robotics and Computer-Integrated Manufacturing, 25(9), 303-313.

Marri, H.B., Gunasekaran, A., Sohag, R. (2007), Implementation of advanced manufacturing technology in Pakistani small and medium enterprises: An empirical analysis. Journal of Enterprise Information Management, 20(6), 726-739.

Ming, X., Yan, J., Wang, X., Li, S., Lu, W., Peng, Q., Ma, Y. (2008), Collaborative process planning and manufacturing in product lifecycle management. Computers in Industry, 59(2-3), 154-166.

Ministry of Industry of the Republic of Indonesia. (2013), Kriteria Usaha Mikro, Kecil dan Menengah Menurut UU NO. 20 Tahun Tentang UMKM; 2008. Available from: http://www.depkop.go.id/index.php?option= com_content&view.

Monge, C.A.M., Rao, S.S., Gonzalez, M.E., Sohal, A.S. (2006), Performance measurement of AMT: A cross-regional study. Benchmarking: An International Journal, 13(1-2), 135-146.

Rahardjo, J., Sutapa, I.N., Widyadana, I.G. (2015), Model Strategi Implementasi Teknologi Manufaktur Tingkat Lanjut (AMT) Untuk Peningkatan Kinerja UKM Makanan, Minuman dan Herbal, KOPERTIS VII. Indonesia: Jawa Timur, Surabaya.

Rahman, A.A. (2008), Buyer-supplier relationships in advanced manufacturing technology acquisition and implementation in Malaysia. International Journal of Economic and Management, 2(1), 95-126.

Rahman, A.A., Bennett, D. (2009), Advanced manufacturing technology adoption in developing countries: The role of buyer-supplier relationships. Journal of Manufacturing Technology Management, 20(8), 1099-1118.

Raymond, L., Croteau, A.M. (2006), Enabling the strategic development of SME through advanced manufacturing systems: A configurational perspective. Industrial Management and Data Systems, 106(7), 1012-1032.

Santoso, S. (2014), Konsep Dasar dan Aplikasi SEM Dengan AMOS 22. Jakartam, Indonesia: PT Elex Media Komputindo.

Sohal, A.S., Sarros, J., Schroder, R., O'neill, P. (2006), Adoption framework for advanced manufacturing technologies. International Journal of Production Research, 44(24), 5225-5246.

Thomas, A.J., Barthon, R., Jhon, E.D. (2007), AMT Implementation: A Review of Benefits and a Model for Change. Cardiff, UK: Cradiff University.