

MEASUREMENT OF THE EFFICIENCY OF SME CLUSTER USING DATE ENVELOPMENT ANALYSIS (DEA)

Ma'ruf, Sidiq P Nugroho, Anton A Setyawan and Muzakar Isa

Faculty of Economics and Business

Universitas Muhammadiyah Surakarta

Corresponding Author: sp122@ums.ac.id, anton.setyawan@ums.ac.id

Abstract

This study explored the efficiency of SME Cluster. We developed an efficiency model consisting of operational capital, labor cost and raw material cost as the inputs. We proposed sales revenue and assets as the outputs of the model. Furthermore, a survey was conducted by involving 83 SMEs in three different clusters. These three different clusters were batik cluster, furniture cluster, and apparel cluster. These clusters had been considered as SMEs with large labor absorption and enormous productivity, particularly in the area of Central Java, Indonesia. Our result shows that most SMEs included in those three clusters are not efficient in operating their businesses. The main problem is related with the cost structure, especially in costly raw materials. In addition, it is suggested to improve the performance of human resource in those SMEs.

Keywords: efficiency, SME clusters, labor cost, raw material cost

Introduction

Currently, industrial clusters have been an industrial development strategy applied widely in many countries (Ding, 2007). It is an effort to establish an extensive business network for the benefit of an industry. Lofving, Safsten, and Winroth (2014) suggested the concept of business networks as a development of a business phenomenon where competition does not occur between companies but between business networks.

The industrial cluster approach is perceived to be appropriate for SMEs since most of them encounter the issues related to resource shortage. Kumral and Deger (2003) argue that companies with limited resources should resort the strategic alliances thus they can use the resources collectively. It is the basis of business networks under the diversification of industrial cluster. A business cluster is basically a group of interconnected companies or businesses, which eventually forms a business network. At the outset, cluster was a geographic concentration of companies or businesses in a particular field. In

its development, it grows into a group of variety of business with diverse roles that ultimately establishes a network (Kuchiki, 2005).

In fact, SME is a dominant business unit in the developing countries, including Indonesia. Nevertheless, this unit frequently faces major issues related to the lack of resources, which cover capital, technology and human resources (Barkley & Henry, 2001). The discourse on the alternatives to resolve SME's limited resources encloses the implementation of resource sharing. Yet this scheme is only possible when business network is established.

The present study attempts to analyze the efficiency of SMEs, particularly in relation with resources, in order to determine and estimate their competitiveness. Several SME clusters were involved, namely furniture cluster, batik cluster, and apparel cluster. These clusters are categorized into the manufacturing industrial cluster. They were selected based on the consideration that the SME clusters in the manufacturing industry have a larger derivative impact in terms of economic

value added and labor absorption (Karaev, Koh, & Szamosi, 2007). Subsequently, the Data Envelopment Analysis (DEA) was employed to measure the efficiency of SME clusters as investigated in this study.

The Development of Sme Clusters

Basically, cluster means groups, yet not all industrial groups can be called cluster. Schmitz and Nadvi (1999) suggest the main characteristic of cluster, namely the sectoral and spatial concentration of firms, or the concentration of similar businesses in certain locations. In fact, there is no definite limit about the geographical proximity among business units in a cluster. It can be located in a specific area, a city to a wider region. Nevertheless, it can also be a cross-country, e.g., Southern Germany and Switzerland. The geographical criterion is actually addressed on the economic efficiency over the existing physical distance and tangible benefits in a variety of profitable business activities (Porter, 1998).

Industrial clusters are geographical concentrations of interconnected companies and associated institutions in particular fields (Porter, 1998). It explains that an industrial cluster consists of several companies with relatively the same characteristics and also supported by the existence of other institutions. Industrial clusters are a group of firms and associated institutions in particular fields that have geographical proximity and interconnection because of "commonality and complementarity" (Kuncoro & Soepomo, 2003).

According to Lamprinopoulou and Tregear (2011), cluster is defined as the gathering of companies in one location and operates in the same industry sector. Meanwhile, Karaev et al., (2007) defines clusters as similar or interrelated companies in a certain geographical location. Cluster can also be defined as the geographical concentration of interconnected firms and their institutions (Waits, 2000).

The innovation in the means of transportation and telecommunications has reduced the importance of geographical proximity, therefore the geographical boundaries become flexible depending on their interests, namely:

- a. In the context of business, cluster is identified over a large area along industrial links. It can cover a village, a district, a province or interrelated provinces.
- b. In the context of the regional development,

geographical boundaries are used to refer the contribution to the regional economic and social well-being.

Benchmarking Smes Performance

Essentially, DEA analysis tool is used to compare a firm's performance from others. In management, such comparison is often referred to as benchmarking. Principally, benchmarking is the continuous process of comparing strategies, processes and products of a firm to other firms or organizations that have better performance, with the aim of learning how they achieve it and then applying the strategy to the firm by making changes suitable to its conditions (Ross, 1995). A successful benchmarking method will improve the firm's performance for providing greater satisfaction to customers.

The conceptualization of benchmarking in business was first developed and implemented by Camp in the 1980s at the Xerox company. Since then, benchmarking has been practiced by various firms in the world. It is perceived to help firms identify their design developments as well as their strengths and weaknesses. Furthermore, it can be used to identify areas hence enable the firm to focus its potential in achieving competitive benefits.

According to Camp (1989) as cited in Shen, Tan and Xie (2000), there are four primary types of benchmarking : internal, competitive, functional, and generic. Internal benchmarking analyzes the best performance in the firm. Competitive benchmarking analyzes the best competitors inside its industry. Functional benchmarking analyzes competitors in industries that have similar functions with the firm. Meanwhile, generic benchmarking analyzes the best business practices in the world.

Longbottom (2000) explicates four stages included in the benchmarking process as discussed below:

1. Planning. This stage includes in-depth observation of the company's internal conditions, analysis of strengths and weaknesses, assessment of performance and preparation of benchmarking.
2. Analysis. In this stage the company identifies potential partners, exchanges information,

- comparison study and the observation process.
3. Application. This stage involves adaptation process and implementation.
 4. Evaluation. At this stage the company conducts evaluation and repetition to attain a continuous improvement.

Research Method

Efficiency Measurement with DEA Method

In the present study, a data envelopment analysis (DEA) is used as programming tool for performance measurement. DEA is a linear programming technique that measures the relative efficiency of decision making units (DMUs) compared to other DMUs in the sample (Yudistira, 2003). It is basically a non-parametric method (Purwantoro, 2004).

The term of DEA was introduced by Charnes, Cooper and Rhodes in 1978. In financial institutions, the inputs and outputs of DMUs are commonly denoted by m and n . Furthermore, the efficiency of each company is measured by the following equation:

$$e_s = \sum u_i y_{is} / \sum v_j x_{is}, \text{ where } i=1, \dots, m \text{ and } j=1, \dots, n, \quad (1)$$

In equation (1), y_{is} is the amount of output produced by the company, x_{is} is the input utilized by the company. Subsequently, the efficiency ratio (e_s) is maximized by using equations (2) as follows:

$$\sum u_i y_{ir} / \sum v_j x_{ir} \leq 1, \text{ where } r=1, \dots, n, \text{ and } u_i \text{ and } v_j \geq 0 \quad (2)$$

This equation (2) ensures that the efficiency ratio must be greater or equal to 1 and positive.

Population and Sample

The population in this study was SMEs in Sragen Regency which were included into 3 (three) different clusters, namely apparel cluster, batik cluster and furniture cluster. Based on the

population, the stratified sampling and purposive sampling were employed as the methods. Stratified sampling is a method of sampling that involves taking samples by paying attention to the strata within the population. Initially, the data were classified into certain strata in which entrepreneurs as the sample must have mastered the start to the final process of a business, and owned a marketing network. Meanwhile, purposive sampling is a method of sampling that entails certain criteria. The criteria included the stakeholders as the industrial actors in the investigated SME clusters in Sragen Regency, the business had been operated at least three years (the age was related to business consistency), and the data of capital asset, labor costs, raw material costs, turnover and tangible assets. Based on these criteria, as many as 84 SMEs met the requirements as the samples. Specifically, there were 26 SMEs of batik cluster, 36 SMEs of furniture cluster, and 22 SMEs of apparel cluster, involved in the present study.

DEA Model

In the present study, the efficiency model refers to the DEA model developed by Wong and Wong (2007). Based on this model, the DEA model of this study can be explained as follows:

Inputs:

1. Capital asset
2. Labor costs
3. Raw material costs

Output:

1. Turnover
2. Company asset

DEA estimation model was used to analyze the efficiency of 84 SMEs as the samples in this study.

Data Analysis and Discussion

The results of the DEA analysis of 84 SMEs revealed diverse efficiency level as detailed below:

1.10 btkmanungg	2.25 btkdewiand	2.79 romaryadik
3.03 ahmadwagim	4.27 mblkatimin	4.33 btkbarokah
4.56 mblsrikunc	4.85 mblsugiyang	4.88 tukiminkon
5.00 btkabimany	5.67 mblsucimul	6.49 afpratamac
7.60 jailanicol	7.70 agusriyant	8.41 btkdewisri
8.89 btktresnok	9.89 arispranat	9.89 mblraku
10.00 btkwinda	10.00 wartocolle	10.35 btknirmala

10.39 mblsumardi	10.55 duaputriko	10.83 btkparno
10.83 btkparno	11.66 mblratnaja	12.46 mblwahyudi
12.86 arbiancoll	14.64 mbldwiputr	14.85 btkbayutum
15.12 nurrohmahk	15.43 btkmulia	15.55 mblsukarno
15.58 mbljarsono	15.58 mbltugimin	15.64 mblkidik
15.70 mblrukidi	16.83 mblrokis	17.59 mblkarno
17.79 mblngatimi	18.21 mblpahing	18.48 mblsarijo
20.50 mblsetu	21.11 btkdaliman	22.02 mblariwibo
22.71 btkpurnama	22.89 mblnugroho	23.04 mbljoko
23.13 mblsrisuta	23.25 budikonvek	23.45 mblsarwono
23.99 Iracollect	24.03 btkmedira	24.77 mblkholid
25.23 mblwardi	25.41 pelangicol	31.17 btkngadiku
36.14 mblabdul	36.42 mblsuwarno	36.74 rubiyemkon
37.50 btkpendawa	38.87 mblparji	40.98 mblmuji
42.01 megacollec	42.74 kusumatext	43.11 mblhidayah
43.43 sujudkonve	48.01 btktarno	50.00 mblsuryant
51.75 faridkonve	62.70 btknakulo	65.36 saidikonve
71.23 btkprasojo	77.38 listinacol	83.33 gazacollec
86.89 mblsugito	93.47 mblsuyanto	98.55 btkganes
100.00 btkalimurt	100.00 btkhuna	100.00 btkkenasti
100.00 btkmhdewi	100.00 btktresno	100.00 mblsuroto

The efficiency analysis shows that only six SMEs have been efficiently operated. They are *Batik Alimurti*, *Batik Mahadewi*, *Batik Huna*, *Batik Tresno*, and *Batik Kenasti* from batik cluster, and *Mebel Suroto* from furniture cluster. The efficiency level of these SMEs has reached 100 percent.

On the contrary, six SMEs have been identified for performing inefficient operation. They include *Batik Manunggal*, *Batik Dewi Andini*, and *Batik Barokah* from batik cluster, *Konveksi Romaryadi* and *Konveksi Ahmad Wagiman* from apparel cluster, and *Mebel Katimin* from furniture cluster. The benchmarking of inefficient SMEs and efficient SMEs has been done. Based on the results of the DEA analysis, the efficiency of inefficient SMEs is specified as follows:

1. Batik Manunggal = 1.1%
2. Batik Dewi Andani = 2.25%.
3. Konveksi Romaryadi = 2.79%.
4. Konveksi Ahmad Wagiman = 3.03%.
5. Mebel Katimin = 4.27%.
6. Batik Barokah = 4.33%.

As explained previously, of the 84 SMEs in the furniture cluster, apparel cluster and batik cluster, only six SMEs have been efficiently operated. Briefly, the remaining 78 SMEs in those three clusters have not been efficiently operated. The sources of the inefficiency mainly relate to the inputs of labor costs and raw material costs.

Basically, the SMEs in the furniture cluster, apparel cluster and batik cluster in Sragen have similar characteristics to the SMEs in general. Nevertheless, labor costs become the main problem for inefficiency due to its low quality of human resources. Sels, Winne, Delmotte, Maes, Faems, and Forrier (2006) argue the vital role of human resources in the improvement of SME's business performance, especially related to operational mechanisms. Likewise, Kato Okamuro, and Honjon (2015) also emphasize the significance of human resources in the process of SME innovation. However, it has not been endured by SMEs in Sragen. The furniture, batik and apparel clusters are perceived to be less attractive for high skill employees, primarily due to the low salary. Consequently, the workers in those SME clusters mostly have low educational background and low skill thus they do not meet the qualifications to work in formal sectors.

Based on the findings in this study, can it be assumed that it is difficult for SMEs to employ skilled human resources? Kato et al., (2015) suggest the role of SME owners as the principal human resources who guide the direction and performance of their businesses. Sels et al., (2006) also verify the strong association between human resource management and SME performance. Human resource is a major factor in business development related to product design, business

processes and SME investment decisions. SME owners are the innovators as well as the operators who lead the business. In the context of SME clusters in Sragen, the role of the owners is very significant regardless their limitation in terms of education and skills. The field observation revealed that many SME owners were incapable in devising appropriate production cost structure. As a result, they could not identify the profit rate of their businesses.

Another source of inefficiency is raw materials. For SMEs, raw materials are an element of the production process and technology. Lofving et al., (2014) explicate that large firms practically implement manufacturing strategies related to the efficient utilization of machinery and technology on a large scale. Nevertheless, it is necessary for SMEs to adjust such strategies due to their smaller volume of production. In fact, during the production process, a relatively high amount of scrap is usually generated. It occurs mostly in wood furniture. Despite the scrap can be altered into other products, yet its economic value is relatively low.

Closing Remark: Establishing Efficient SMEs

A study on the efficiency of production-related activities of SMEs in Sragen has been carried out. Based on the DEA analysis employed in this study, only 6 (six) of 84 SMEs can be classified efficient in operating their activities while 78 SMEs are not. The reasons for this inefficiency are the problems related to human resource and raw materials.

The quality of human resources of the furniture, batik and apparel clusters in Sragen is a main hindrance for the efficiency of most SMEs. Yet, there are opportunities to acquire high skill human resources by positioning SME owners as the manager as well as the operator. Consequently, they are motivated to accelerate and improve the performance of their businesses. Furthermore, raw materials are another issue linked to the technological applications in which the current production is primarily done based on traditional methods. The application of modern technology can be a solution. Finally, this study suggests the Total Quality Management and Six Sigma to improve the efficiency of SMEs in Sragen since the concepts are very relevant to their SME clusters.

REFEENCES

- Barkley, D. L., & Henry, M. S. (2001). Advantages and disadvantages of targeting industry clusters. REDL Research Report Clemson University.
- Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European journal of operational research*, 2(6), 429-444.
- Ding, K. (2007). Domestic market-based industrial cluster development in modern China. *Discussion Paper Institute of Developing Economies*.
- Karaev, A., Koh, S. C. L, Szamosi, L. T. (2007). The cluster approach and SME competitiveness: A review. *Journal of Manufacturing Technology Management*,. 18(7), 818 – 835.
- Kato, M., Okamuro, H., & Honjon, Y. (2015). Does founders' human capital matter for innovation? Evidence from Japanese start-ups. *Journal of Small Business Management*, 53(1), 114–128.
- Kuchiki, A. (2005). Theory of a flowchart approach to industrial policy. *Discussion Paper Institute of Developing Economies*.
- Kumral, N., & Cagacan, D. (2003). An industrial cluster study: as a basis for the Aegean regions development policy. A paper for Reinventing Regions in the Global Economy. Regional Studies Association, 12 -15 April 2003, Pisa Congress Center, Pisa, Italy.
- Kuncoro, M., & Supomo, I. A. (2003). Analisis informasi keterkaitan pola kluster dan orientasi pasar, studi kasus industri keramik Kasongan, Kabupaten Bantul di Jogjakarta. *Jurnal Empirika*, 16(1).
- Lamprinopoulou, C., Tregear, A. (2011). Inter-firm relations in SME clusters and the link to marketing performance. *Journal of Business & Industrial Marketing*, 26(6), 421–429.
- Lofving, M., Safsten, K., & Winroth, M. (2014). Manufacturing strategy frameworks suitable for SMEs.

Journal of Manufacturing Technology Management, 25(1), 7-26.

- Longbottom, D. (2000). Benchmarking in the UK: An empirical study of practitioners and academics. *Benchmarking An International Journal*, 7(2).
- Porter, M. E. (1998). Clusters and the new economics of competition. *Harvard Business Review*, November-December.
- Purwanto, N. (2004). Efektivitas kinerja pelabuhan dengan data envelopment analysis (DEA). *Usahawan*, 5, XXXIII.
- Ross, J. E. (1995). *Total quality management: Text, cases & readings*. London: St. Lucie Press.
- Schmitz, H., & Nadvi. (1999). Cluster and industrialisation: An introduction. *World Development*, 27(9), 1503-1514.
- Sels, L., Winne, S. D., Delmotte, J., Maes, J., Faems, D., & Forrier, A. (2006). Linking HRM and small business performance: An examination of the impact of HRM intensity on the productivity and financial performance of small businesses. *Small Business Economics*, 26, 83-101.
- SHEN, X. X., TAN, K. C., & XIE, M. (2000). BENCHMARKING IN QFD FOR QUALITY IMPROVEMENT. *BENCHMARKING AN INTERNATIONAL JOURNAL*, 7(4).
- Waits, M. J. (2000). The added value of the industry cluster approach to economic analysis, strategy development, and service delivery. *Economic Development Quarterly*, 14(1).
- Yudistira, D. (2003). Efficiency in Islamic bank: An empirical analysis of 18 banks. Loughborough University, UK.