

DEFINING TECHNOLOGY STRATEGY FOR SMALL TO MEDIUM ENTERPRISE WITHIN LEAN AND GREEN MANUFACTURING FRAMEWORK

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ABSTRACT

Entering the new globalization, Small to Medium Enterprises (SME) in Indonesia were hardly facing the tight competition. Some of them were simply change their business value from acting as a manufacturer becoming a trader. Perhaps, importing a product from abroad and put a label or a package considered as the best alternative to survive within the competition. This paper present a step by step technology implementation scenario as the business strategy to conform lean and green manufacturing concept. Lean and green concept has to be taken as the customer value fulfillment and to achieve an efficient production process in particular. The implementation scenario provide an ongoing strategy to become flexible and efficient manufacturer player within the budget and resource limitation. Value of potential profit and potential lost has been presented to seek the best strategy for individual or clustered SME.

Key words: small to medium enterprise, lean and green manufacturing, technology strategy.

1. INTRODUCTION

The generic problem of SME hardly facing the competition is falling to achieve the number of finished goods in the expected price and quality. It is very important to understand the concept of production rate, production capacity, utilization, availability, and manufacturing lead time (Groover, 2008). Most of the time the SME doesn't have passion to measure those manufacturing performance number or level. In order to have a very good product, the design process should comply with suitable technique and accurate activity (Pugh, 1996). These technique is follow material science, specification control, concept to detail design, quality and product reliability. Further the steps for design activity are market analysis, synthesis, decision making, analysis, costing, and manufacturing. An efficient layout for production process also take the improvement of productivity and reducing the cost (Heragu, 2008). Such problem for ineffective material handling and excessive transportation are often found in the SME, thus layout improvement is essential.

SME in Indonesia has a unique characteristic, where almost all business function rely on a single person or limited human resources. Thus, a simple and tactical

strategy should be offered to have a quick impact and easy to implement within the production process and business framework. Some business might compete with their own member of existing industrial cluster, while other might busy to follow the current trend of product made by the competitors, so that a very strong competition happens all time.

This paper offers a generic idea in defining technology strategy to answer the competitive advantages of lean and green manufacturing. The presented data is taken from an observation and consultation towards 140 SME in East Java Province, Indonesia. These SME having their business around wears, food and drinks including cake and snack, daily needs such as soap and detergent and also local handicraft. Starting with the description about product innovation for the new entrance and existing SME, analysis of current lean and green level, in the end a formulated technology strategy and scenario is presented to get the sense of practical implementation. The adaptation of aspects in lean and green manufacturing regarding concept, product and or process focus, methods, employee involvement and supply chain involvement (Johansson & Winroth, 2009) were carefully taken in the offered strategy and scenario.

2. THEORETICAL BACKGROUND

To win the current global competition, there must be innovation in any part of business function in SME. SME should have sufficient entrepreneurship motivation to achieve maximum performance (Kurniawati & Yuliando, 2015), a gradual step by step innovation through precise planning-implementation-platform-performance (Liu, Li, & Zhang, 2012), adequate implementation of Good Manufacturing Planning (Ghazilla, Sakundarini, & Abdul-Rashid, 2015), and cope with unstable demand or customer (Spena, Holzner, Rauch, Vidoni, & Matt, 2016).

In fact, the business growth of SME is really depend on its business community. It means that if there is no strong diversification of product, in a definite time one or more SME were slightly disappear in the competition. Some external factors can be an advantages and disadvantages, these are government support in the capital of human-organizational-technological-social (Michael, Saban, & Abdurahman, 2016), identification of barriers to imitation strategy (Lewis, 2000) and managing the risk (Smit & Watkins, 2012). Thus the competition in the era of lean and green become harder in regard to these external factors readiness.

Several methodology can be followed to become a new look of SME that cope with lean and green perspective. The methodology should cover these criteria: a dynamic learning process or increase the SME flexibility (Holweg, 2007), linking the strategy and technology (Zarrabi & Vahedi, 2012), and product reengineering process (Bourletidis & Triantafyllopoulos, 2014). In order to deal with the methodology, an SME should aware with some strong point of survival such as the capability of social network, computerized record, online marketing (Rahman, Yaacob, & Radzi, 2016), together with the maturity of business towards innovation capability (Aziz & Samad, 2016).

To become a lean and green manufacturer, SME should have multi-years' experience in doing a particular business field. Most of SME has problem with skilled worker as the limited salary (Musa & Chinniah, 2016), thus the

continuous improvement to comply with lean and green framework would be difficult. It will require a comprehensive record of production activities. A succeed SME needs an appointed board to do consultation and audit (Jaswadi, Iqbal, & Sumiadji, 2015), sufficient level of technology readiness (Nugroho, 2015), appropriate process of technology transfer (Herliana, 2015), and a good surrounded environment of economy (Ahmedova, 2015).

It is very important to have a simulation for human operator to adapt with new technology. In this case, the adaptation to the changing of automation configuration such modification of manual process into a semi-automatic system. The issues are situation awareness, information-processing ability and working-memory capacity (Jipp & Ackerman, 2016). Towards a simple business sense of certain SME, it will helps their limitation for production time and resource availability.

A leader in technology does not always have the best return on sale or mean revenue growth, because the discovered technology were easily imitated (Muhammad, Jantan, & Keong, 2008). However, the process of imitation should consider the overall possibilities of production methods for a particular section within shop floor (Wessel & Gorchach, 2008). Therefore, to achieve an efficient process – several steps that have to be followed are: production plant model, calculate the required energy, machines classification, product families based on group technology concept, and critical aspect of the proposed innovation (Papetti, Marilungo, Gregori, & Germani, 2016). To support those efficiency, a particular consideration of a good supply chain should be defined. This will end to several important performance indicator such as procurement volume, networking type regarding of its speed and the required investment (Chen & Papazafeiropoulou). Further, in an advanced developed – an SME should have the mechanism of planting tacit decision knowledge into the system in order to have simplified information gathering (Fast-Berglund, Akerman, Karlsson, Hernandez, & Stahre, 2014).

Lean and green manufacturing concept becoming a good new trend with the positive

impact toward production process. It can be simultaneously applied to reduce waste as the characteristic of lean manufacturing together with the effort of become environmental friendly as the main principle of green manufacturing (Prasad & Sharma, 2014). The concept of industrial ecology, however, have a bigger impact if it is used for broaden the framework of lean and green (Ehrenfeld, 2004). SMEs symbiosis is very important to build a positive interdependence and business network. This symbiosis also can be implemented in a SMEs cluster, at least for taking the waste treatment within a group rather than individually. The challenge in waste treatment would be the impact of how green is the manufacturing technology of SME, such as currently use of non-renewable energy or the amount of fuel consumption (Paul, Bhole, & Chaudari, 2014).

Beside its advantages, area of lean and green manufacturing has difficulties and limitation to learn. A very limited publications shows a comprehensive applied example for each type of industry, 59% of empirical study in comparison with 31% of theoretical study make the search of application method and result become hardly to find (Hartini & Ciptomulyono, 2015). The study related to environmental product development as the starting point of green manufacturing is also limited. The limitations are the suggestions were normative, busy to introduce a new tool instead of studying the existing, a poor relationship between strategic and technical content, fail to describe a bigger concept of product development and insignificant description of policy making influence toward the system (Baumann, Boons, & Bragd, 2002). A small niche of difficulties of combining lean and green is about the view of resource usage, while lean take it as a valuable with the full exploitation – green realize that environment could be the boundary of producing the product. Optimizing resource based on lean manufacturing by using overseas raw material in particular, will not meet the basic character of green manufacturing of reducing transportation that cost of unexpected emission (Dues, Tan, & Lim, 2011).

3. RESEARCH METHOD

To achieve higher productivity and win global competition, empowering the local strength will be also an important point of a milestone. The customer, however, most of the time are willing to buy the cheapest product or the trendsetter product which often coming from abroad. Thus win the customer mind for local product should be reached.

First, a literature survey of lean and green manufacturing framework has been done to build a particular framework for SME. This survey was followed by production process and business survey to 140 SME in East Java Province Indonesia. Business survey, in addition, has been taken towards hundreds of a potential newcomer of business in similar products with a result of poor intention of creating innovative product as can be seen in Table 1.

Table 1: Willingness to produce innovation

Product	Price Index	Mean
Wears 1	0.5	7.00
Wears 2	0.5	5.00
Wears 3	0.1	7.00
Wears 4	0.75	3.00
Wears 5	0.25	5.67
Foods & Drinks 1	0.05	9.00
Foods & Drinks 2	0.1	8.50
Foods & Drinks 3	0.03	0.00
Foods & Drinks 4	0.03	0.00
Foods & Drinks 5	0.1	3.00
Daily Needs 1	0.05	7.67
Daily Needs 2	0.1	5.00
Daily Needs 3	0.05	0.00
Daily Needs 4	0.1	0.00
Daily Needs 5	0.05	3.00
New Products 1	0.05	0.00
New Products 2	0.1	0.00
New Products 3	0.2	0.00
New Products 4	0.5	0.00
New Products 5	1	0.00

Note: mean in level of 0 to 9 for 10 zones

Second, for each SME it was defined production rate, production capacity, utilization, availability, and manufacturing

lead time within the framework of lean and green manufacturing. This can be done by asking the potential customer about their future demand in regard to volume and delivery time. Following the demand, the SME then decide the relevant production volume and finishing time. Thus, the supplier also has the similar information and do the alignment. The result was all the target for manufacturing operation variable.

The next step was defining the particular technology strategy in order to comply with the expected target. The target will be divided into stages in particular period of time. Starting with analyze the production stages, search the possibility of automation (higher level of technology), identify the technology features, calculate the production parameter, machine system design through Quality Function Deployment (QFD) steps.

Finally, taking the advice of technical advantages and limitation – the prototyping process will be done. Followed by testing and running the production process. Moreover, the evaluation will be based on the achieved target and also how effective the marketing and sales.

4. RESULT AND DISCUSSION

A particular questions and observation has been done towards the 140 SME. The particular business function is about production process and business concept. Production process consist of raw material purchasing and processing, transforming into goods and packaging. The business concept is based on related Computer Integrated Manufacturing Open System Architecture (CIMOSA) framework which consist of strategic level, operational level of product development-process, and support level of financial record-maintenance-information technology. The result of both production process and business process has been described in Table 2, in respect to the lean and green manufacturing concept and targeted score within 3 years of improvement.

Table 2. Performance of Lean (L) and Green (G)

Criteria	Current		Target	
	L	G	L	G
Production Process (scale of 5)				
Raw material purchasing & processing	2.7	1.8	3.2	2
Transforming into goods	2.8	1.9	3.3	2.1
Packaging	3.5	2.1	3.8	2.4
Business function (scale of 5)				
Strategic level	2.1	2.6	2.6	2.8
Operational level	2.2	1.5	2.6	2
Support level	2.4	2.9	2.8	3.1

In terms of improvement of current productiivity and business value to achieve the lean and green level, a spesific project target has been created in order to have clear idea of achievement within particular milestone of 3 years performance. This scenario is shown in Table 3 as follow.

Table 3. Machine System Building

Automation Improvement – Machine System Prototyping (MSP) – Project Phase					
Identification of needs			Technology features		
Machine Sytem Design (technical parameter)			Production Parameters (Operational Manufacturing)		
Prototyping – Testing - Running			Project target and marketing to seek new customer		
Year 1		Year 2		Year 3	
Running		Running		Running	
-	MSP	-	MSP	-	MSP

In order to have better machine system design that can be fulfilled by directly buy from the exixting machines or produced by customized machine that can be aligned with the expected level of technology, an approach of HOQ has been taken. Starting with the customer requirement factor that is taken from the expected performa by SME, then followed by technical requirements that should be answered by the machine system designer. This has followed a particular production phase within each of the SME, an example of this cn be seen in Table 4. Further

the relation between technical requirement and component characteristic also has carefully taken to identify correct component for machine system. A typical HOQ relation can be seen in the following Figure 1.

Table 4. A typical production stages

Raw Material (or ingredient) Handling
Tranforming into goods – Process 1
Packaging
Finished goods – products

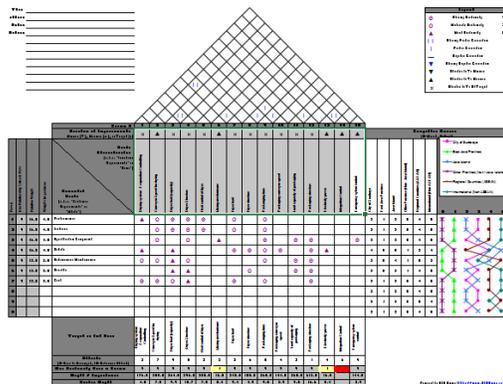


Figure 1. The use of HOQ design

Currently, 20 % of concept and 5% of prototype has been produced. As a result, the particular SMEs were in progress of doing their new production process and business concept. An example of prototyping can be seen in Figure 2. The flexibility toward the change should be tested. Several approach of marketing and selling has been implemented followed by the experiment of production facilities sharing. The volume of sales is increased by 20% and the operation time and other manufacturing operation parameter getting better in about 15%.



Figure 2. A prototyping result

5. CONCLUSION

A step by step technology strategy has been given in order to achieve higher productivity within the concept of lean and green manufacturing. A simple rule of lean and green has been adapted in order to achieve a small improvement of competitive advantages.

Machine system concept and prototype has been produced for each SME. A three year targeted to finish the concept for each UKM and prototype for piloting will be likely finished. As the production concept and relevant marketing and selling strategy has been informed to be run in the business framework of SME.

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