Applying Cleaner Production Concepts in Improving Quality of Environment

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Abstract: Sometimes the economic growth ignores the environment. As a result, the Asian Productivity Organisation (APO) had introduced the concept of cleaner production (CP) in the mid-1990s. CP can reduce cost, based on competitive advantage and environmental aspect approaches. The logic behind the CP practices are to: reduce, reuse, recycle, reproduce and recovery (i.e., 5R). They are basic requirements for producing high quality products and services, with little or zero waste, while maintaining high levels of product competitiveness.

This paper presents the results of CP implementation survey conducted among Indonesian SMEs. Out of 54 companies, 28 companies (51.85%) were applying CP in their environmental protection; 6 companies (11.11%) were applying 3R (reduce, reuse, recycle); 11 companies (20.37%) go for reduce and reuse (2R) only; and 9 companies (16.67%) were practicing one R only in reducing their material usage in production line. The authors also found that 1 company (1.85%) had reduced 70% of their production cost by decreased rework, waste and energy saving contributed to the environment. The main finding from the study showed that CP activities provide environmental improvement which is crucial for the CP implementation and it contribute competitive advantage in Indonesian SMEs.

Key-Words: Continuous improvement, Cleaner Production practices, Waste management

1 Introduction
Globalisation impacts and its associated demands in competitive environment have created a need for managers in manufacturing sectors to take decisive actions, responsive to environmental changes, and implement strategies that continually improve quality, capability and process efficiency. The efficiency in continually improving the quality of products and its processes could be seen in term of cost reduction, improvement of customer satisfaction as well as minimize the environmental impacts.

The paradigm of productivity is undergoing an evolution and the scope of productivity has expanded over the years. There is also a concern that economic growth ignores the environment. As a result, the Asian Productivity Organisation (APO) had introduced the concept of Cleaner Production (CP) in the mid 1990s [1]. CP is a strategy for enhancing productivity and environmental performance for overall socio-economic developments. Productivity provides the framework for continuous improvement (CI), while environmental protection
provides the foundation for sustainable development [2, 3]. The Basic of CP concept is shown in Fig. 1 [4].

![Production Process Diagram](image)

**Fig. 1 Application of Cleaner Production on Production System [4]**

The foundation of the CP concepts is to plan, examine, re-evaluate and maintain the production processes to highlight ways of improving productivity, while reducing its environmental impacts through four main activities or also called as 4Rs (Reuse, Reduce, Recycle and Reproduce), or including other one more R (Recovery). CP means persistent used of industrial processes, raw materials and products designed from their inception to prevent pollution of air, water and land; in order to reduce waste, to minimize the risks of environment and human health, and to make efficient use of raw materials, such as energy, water and space [5]. Implementation of these concepts leads to another cycle of review or evaluation thus promotes continuous improvement (CI) activities [1]. CI is a win-win approach for simultaneously realizing improvements in productivity and environmental protections. Continuous improvement (or kaizen activities) on the products and processes create substantial opportunities for pollution prevention and waste minimization, product improvement as well as customer satisfaction [6]. CP concepts are considered less costly to implement, operate and maintain over time because the CP activities can reduce costs of raw materials, energy, pollution control, waste treatment and clean-up, and continued regulatory compliance [7].

The CP concept was launched in 1989 in response to a decision from the United Nations Environment Programme (UNEP) Governing Council on the need to reduce global industrial pollution and waste. Until the 1990s, the manufacturing sectors were managing its environmental problems almost exclusively through end-of-pipe solutions [8]. By using the end-of-pipe approach, production departments avoided the need for changes and closely monitor the processing area and they are discharged from all waste responsibility. In Indonesian SMEs, end-of-pipe treatments would be subsidized up to 30 percent by the government, and prevention could only be achieved through new investments fully financed by the private sectors or private companies at their own initiatives and efforts [9]. This factor made the introduction of CP in Indonesia could be more difficult if no sufficient supports from the government and private sectors.

This research aims to investigate the level of cleaner production practices and its activities in Indonesian SMEs. One of the aim was to determine whether the CP implementation has a significant
contribution to the successful of business activities in context of Indonesian SMEs. This study also would offer some current or snapshot information pertaining to the level of CP practices in Indonesian SMEs. The research was carried out in the SMEs in Pulogadung, Indonesia. Indonesian SMEs have grown mainly on the initiatives of private sectors and its share in the manufacturing sector is over 35 percent. SMEs have provided employment to be over 13.6% (7,592,510 man power) [9].

2 Methodology
The CP methodology relies on the creation and keeping well organised, effective and efficient resources usage (e.g. man, materials, energy and equipment) through effectively using the above 4Rs. The collection of data has been carried out in 54 SME companies, which they are leather, textiles and food companies. The study was conducted between March and Jun 2008. The companies were selected because they provided specific insights into the subject of inquiry. The company performance, production processes and its environment were considered essential for increasing the product's competitiveness and decreasing environmental impacts. This research used questionnaire survey and interviews, as well as literature search in gaining empirical evidences [10]. At initial stage, the CP concept/methodology was introduced to managers and the CP degrees of agreement have been explained to the management/respondents. The CP degrees or scores used are as follows: 5– Extremely Agree; 4–Very Agree; 3– Agree; 2–Poor; 1–Extremely disagree. The study was conducted in the natural environment of the organization, with minimum interference from the researchers into their normal flow of works.

In order to achieve the objectives, the inspection rule of the CP activities was categorized based on their degree of practices [5]. The questionnaires were distributed and in consequence to the great changes of CP practices that have appeared in the companies, the categories are divided as follows:

- 1-R: Medium & high usage of materials and immediate usage of energy,
- 2-R: Minimum scrap/disposal and high usage of tools and materials,
- 3-R: Integrated of material and parts, application of CAD/CAM technology, application of CIM and FMS; decreased usage of hazardous materials, reduced scrap and waste/disposal, decreased reject or Not Good (NG) product, energy preservation (aircon temp. mark/switch) and usage of water waste management installation (IPAL),
- 4-R: Reproduce or rework.

As shown above and based on Fig. 1, the CP practices can be simplified in this study and it was identified by, namely 4-Rs concept: Reuse (1-R); Recycle (2-R); Reduce (3-R); Reproduce (4-R). The questionnaires were also designed to obtain some others information pertaining to the CP activities such as management perception on the existing systems; methods used for improving quality; production effectiveness (manufacturing overhead/sales), production equipment used (sales/net value of production equipment), and productivity (sales/number of employees) and the other CP related practices.

2.1 Selection of Companies
The companies were selected based on their willingness to participate in the study. This research is focused on the SMEs in Pulogadung which represent industrial estate area in Indonesia. They were also classified into four groups, which based on the stage of business development and the contract situation with the customers [11]:

- Stage 1 - Products (parts and components) are for after-market.
- Stage 2 - Quality, Cost, and Delivery (QCD) of the products which have not reached the audit level of the particular customer yet.
Stage 3 - Contract with the particular customer is unstable.
Stage 4 - Contract with the particular customer is stable; and

Table 1 Company Criteria Based on Technology Applied

<table>
<thead>
<tr>
<th>Score (Mark)</th>
<th>Rating Criteria for Sub-Items</th>
<th>International Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Equipment and Technology appropriate from the viewpoint of quality product requirement</td>
<td>Average level of Original Equipment Manufacture (OEM) part Industries in industrialised countries</td>
</tr>
<tr>
<td>4</td>
<td>Mostly appropriate equipment and technology are used, though some of them need improvement</td>
<td>Top level in ASEAN parts industries except for companies with foreign capital</td>
</tr>
<tr>
<td>3</td>
<td>Inappropriate equipment and technology are used at a considerably high rate. Some are missing</td>
<td>Average level in ASEAN parts industries except for companies with foreign capital</td>
</tr>
<tr>
<td>2</td>
<td>Inappropriate equipment and technology are used, causing poor quality of products</td>
<td>Lower level in ASEAN parts industries except for companies with foreign capital</td>
</tr>
<tr>
<td>1</td>
<td>Obsolete and out-of-date equipment and technology are used. Cottage industry level</td>
<td>The lowest level in ASEAN parts industries</td>
</tr>
</tbody>
</table>

The company criteria is also evaluated based on their equipment and technology levels applied, which is shown in Table 1 [11]. The population of this study comprises all the certified SME companies in Pulogadung. The study looks at the data gathered from each SMEs and treats each respondent as an individual data source. As the number of certified SMEs in Pulogadung are about 3016 companies (in 2006), the choice of method has to be one that allows all of the selected certified sites to be surveyed. A survey enables the collection of a sufficiently large and representative sample for analysis. The questionnaire data from all 3016 companies were used to analyse, produce a report and constitute the research database. Out of these 3016 companies, they are only 54 companies have showed or revealed significant to further study the CP activities in their companies. Since the certified sites are located all over Pulogadung, an interview with these 54 companies seemed to be the most appropriate method to enhance the data collection and improve the quality of information.

3 Results and Discussion

The first aspect analysed was the general company profile. Companies breakdown were based on the size of the companies. A proportion of 31 companies (57.41%) were classified into medium-sized enterprises, employing between 99 and 300 employees. The other 23 companies (42.59%) were classified into small sized enterprises, having less than 99 employees. Based on company ownership, 5 companies (9.26%) were classified into joint venture and 49 companies (90.74%) classified as local investment.

From the CP practices, out of 54 companies, there are 31 medium-scale companies (57.41%) have practiced the 4-R concepts in their organisations. About 23 small-scale companies (42.59%) have come across the 4-R concept. The breakdown of CP practices is shown in Table 2.
Table 2 CP Implementation at Company

<table>
<thead>
<tr>
<th>Type of Company</th>
<th>Reuse (5.56%)</th>
<th>Reuse and Recycle (9.26%)</th>
<th>Reuse, Recycle and Reduce (7.41%)</th>
<th>Total (57.41%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium Scale</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small Scale</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>9 (16.67%)</td>
<td>11 (20.37%)</td>
<td>6 (11.11%)</td>
<td>54 (100.00%)</td>
</tr>
</tbody>
</table>

Out of these 54 companies, 6 companies (11.11%) admitted involved in implementing Reuse, Recycle and Reduce at their process manufacture. About 11 companies (20.37%) indicated that they have implemented Reuse and Recycle, and 9 companies (16.57%) implement Reuse in their process manufacture. Majority of the companies 28 companies (55.56%) have actually built the concept into their day-to-day activities without realizing that it is a well established CP practices. The study was also revealed some information on ISO certification and it was carried out in the two categories as shown in Table 3. Out of 54 companies, 33 companies (61.11%) indicated that they are certified by the environmental standard system (ISO 14000 series) practices in their organisations. About 21 companies (38.89%) indicated that they have not yet implemented the ISO 14000 in their organizations or certified by the standard. The comparison between the ISO certification and CP implementation is shown in Table 4.

The percentage average on energy usage, starting January to June 2008 is shown in Fig. 2. It showed that only 1 company can save the energy usage up to 30%. The results presented in Fig. 2 confirmed that the 54 selected SMEs have increased the productivity on manufacturing system (saving of energy usage). The data shown that the CP implementation has significant contributed to the business competitive advantage in these organisations. This revealed that the implementation of CP initiatives can produce significant improvements in term of productivity and competitiveness in various organisations.

Table 3 Company and ISO 14000 Certification

<table>
<thead>
<tr>
<th>Company</th>
<th>ISO</th>
<th>Non-ISO</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium Scale</td>
<td>28 (51.85%)</td>
<td>3 (5.56%)</td>
<td>31 (57.41%)</td>
</tr>
<tr>
<td>Small Scale</td>
<td>5 (9.26%)</td>
<td>18 (33.33%)</td>
<td>23 (42.59%)</td>
</tr>
<tr>
<td>Total</td>
<td>33 (61.11%)</td>
<td>21 (38.89%)</td>
<td>54 (100.00%)</td>
</tr>
</tbody>
</table>

Table 4 CP Implementation with Regards to ISO Implementation

<table>
<thead>
<tr>
<th>Type of Company</th>
<th>Reuse (5.56%)</th>
<th>Reuse and Recycle (9.26%)</th>
<th>Reuse, Recycle and Reduce (7.41%)</th>
<th>Reuse, Recycle, Reduce, and Reproduce (55.56%)</th>
<th>Total (100.00%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium Scale</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Small Scale</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
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<td>6 (11.11%)</td>
<td>54 (100.00%)</td>
<td></td>
</tr>
</tbody>
</table>
4 Conclusions
The conclusion of the research suggested that practice and theory should be closely related and any differences in the implementation of CP can be attributed mainly in the maturity of the continuous quality improvement programmes. Clearly, this is a great information for the application of CP concepts in the Indonesian SMEs environment as their workplaces are expected for productiveness and effectiveness.

This paper outlines the results of CP implementation survey conducted among 54 Indonesian SMEs. Out of 54 companies, 28 companies (51.85%) were applying CP in their environment unnoticeable; 6 companies (11.11%) were applied reduce, reuse, recycle (3R); 11 companies (20.37%) were applied reduce and reuse (2R); and 9 companies (16.67%) applied reduce (1R) of material used in production line. The authors were also found that 1 company (1.85%) has reduced their production cost up to 70% by decreased of reworks, energy saving and waste contributed to the environment. The main finding from the study proved that CP activities provide an essential quality improvement which is an important base for CP implementation and successfully contribute to a competitive advantage in Indonesian SMEs.

References:
