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Application Of Sustainable Productivity Management In Footwear Companies By Green Manufacturing Approach

Uly Amrina[1] dan Novera Elisa[2]
[1]Industrial Engineering Department, Faculty of Engineering, Universitas Mercu Buana
Jl. Raya Meruya Selatan, Kembangan, Jakarta 11650
E-mail : [1]uly.amrina@mercubuana.ac.id, [2]novera_elisa@mercubuana.ac.id

Abstrak--- *Kebutuhan industri untuk memiliki proses manufaktur yang berkelanjutan adalah suatu keharusan yang harus dipenuhi, mengingat tiga pilar, yaitu lingkungan, sosial dan ekonomi. Segala jenis industri pasti akan mengejar keuntungan, dan salah satu cara untuk meningkatkan keuntungan adalah dengan meningkatkan produktivitas proses, tanpa mengorbankan lingkungan dan sumber daya manusia. Untuk alasan ini, manajemen produktivitas green diperlukan untuk menjamin kinerja dimensi yang diukur dalam jangka panjang. Dalam praktik operasional, setiap departemen memiliki ukuran kinerja produktivitas masing-masing. Penelitian ini dibuat untuk merancang manajemen produktivitas yang telah mengintegrasikan tiga dimensi manufaktur green yang meliputi lingkungan, sosial (sumber daya manusia) dan ekonomi. Integrasi pengukuran akan dilakukan dengan menggunakan metodologi produktivitas green dengan mempertimbangkan lima parameter manufaktur, yaitu pendapatan, biaya produksi, residu bahan padat, limbah kimia berbahaya, dan kondisi keselamatan dan kesehatan kerja. Ada lima langkah untuk membangun perhitungan produktivitas berkelanjutan, yang terdiri dari menentukan proses, menetapkan target, memahami pengukuran aktual, menghitung indeks produktivitas berkelanjutan, analisis dan aktivitas perbaikan. Hasil dari penelitian ini adalah untuk mencapai produktivitas yang berkelanjutan, perusahaan perlu meningkatkan rasio produktivitas ekonomi dan dampak sosial lingkungan. Di perusahaan sepatu, dengan mengelola kegiatan 3R (mengurangi, menggunakan kembali, daur ulang), perusahaan dapat mencapai sebagian besar target kinerja berkelanjutan (produktivitas 89,1%, limbah padat 195,9 gram / pasangan, kasus P3K 9 kasus, dan kecelakaan kecil 0 kasus), namun limbah berbahaya masih dekat untuk mencapai target. Kinerja tersebut dapat meningkatkan indeks produktivitas berkelanjutan selama Desember 2018 - Maret 2019. Penelitian ini diharapkan bermanfaat bagi lingkungan akademik dalam mengembangkan penelitian lebih lanjut, serta bagi industri manufaktur untuk mencapai produktivitas green.*

Kata Kunci--- *Produktivitas, Green, Ekonomi, Lingkungan, Sosial*

Abstract--- *The industry's need to have a sustainable manufacturing process is a must to be met, considering three pillars, namely environmental, social and economic. It has become a necessity that all types of industries will surely pursue profit, and one way to increase profits is to improve the productivity of the process, without sacrificing environment and human resources. For this reason, a green productivity management is needed to guarantee the performance of the dimensions measured in the long term. In operational practice, each department has its own measure of productivity performance. This research was made to design a productivity management that has integrated three dimensions of green manufacturing which includes environment, social (human resources) and economics. The integration of measurements will be carried out using green productivity methodology by considering five manufacturing parameters, namely income, production cost, material solid residue, hazardous chemical waste, and labor safety and health condition. There are five footsteps to construct sustainable productivity calculation, that consist of determining the process, setting the target, grasp actual measurement, calculate index of sustainable productivity, improvement and analysis. The result of this research is to achieve sustainable productivity, the company need to improve both economic productivity ratio and environment social impact. In footwear companies, by managing 3R (reduce, re-use, re-cycle) activities, the company could achieve most of sustainable performance target (productivity 89,1%, solid waste 195,9 gram/pair, first aid case 9 cases, and minor accident 0 cases), however hazardous waste still near to achieve the target. Those performance could improve the sustainable productivity index during December 2018 – March 2019. This research is expected to be beneficial for the academic environment in developing further research, as well as for the manufacturing industry to achieve green productivity.*

Keywords--- *Productivity, Green, Economic, Environment, Social*

1. INTRODUCTION

The footwear industry is one of manufacturing industry that contributes positive economy in Indonesia. Based on National Industrial Development Plan from the Ministry of Industry, the footwear industry is ranked third in the priority

industry, and is expected to continue to increase in the future (Pusat Komunikasi Publik, 2015). This can be achieved if the manufacturing industry increases competitiveness by improving the internal performance of the process, making efficiency on its production costs so that it can compete to fight the swift flow of imports in the era of free trade.

The performance of a manufacturing process is generally measured by productivity indicators, which are mathematically formulated as the ratio of output to input (Amrina & Firdaus, 2018). Appropriate productivity calculations are needed to assess the efficiency of resource use in achieving economic and non-economic goals in the future (Sumanth, 1997). As a labor-intensive and capital-intensive industry, the footwear company tends to concentrate more on increasing profits by saving resources to a minimum, without considering environmental and social factors. Product innovations that are developed often require the use of materials, machinery and processes that cause negative contributions to the environment and the social conditions of workers.

The footwear company is possible to produce solid waste and hazardous waste that has an impact to the environment. This will endanger the health of human resources and the eco-system, and possible to create additional costs that erode the value of profitability. While from a social point of view, workers health and safety are important factors in creating a stable social environment (Hasibuan & Hidayati, 2018). Healthy workers will create healthy and prosperous families, and healthy and prosperous families will create a stable social environment. From a narrow perspective, attention to the environment and the social will only increase operational costs, but from a holistic perspective, the integration of these dimensions will improve productivity and bring economic benefits in the future.

Footwear industry tends to calculate its productivity in the production department as stand alone, based on the total products manufactured compared to the resources released. While environmental department measure how much scrap is wasted compared to the standards set by regulations. In addition, the finance department calculates productivity as ratio of income to costs. But no one can ascertain whether high productivity and good profit ratio will guarantee a sustainable production process. For this reason, a productivity calculation that integrates environmental, social and economic dimensions together is needed. The integration of these three dimensions in a manufacturing process is known as the concept of green manufacturing, which is a concept that develops a sustainable manufacturing process (Dornfeld, 2012). Green manufacturing could eliminate losses and pollution resulted from production process through well management of materials, utilities or energy, and safety health issues (Ikatrinasari, Hasibuan, & Kosasih, 2018).

This research is aimed to help footwear companies to manage sustainable productivity that can guarantee the performance of the dimension measured in the long term to win global competition. To realize the aim, this study will applicate Green Manufacturing Approaches, which focused on the waste identification visualization using process pollution output (Gupta, Narayanamurthy, & Acharya, 2018), continue with productivity calculation using APC model with Green Productivity Index (Marizka, Djatna, & Arkeman, 2015). Researchers observe and collect research data in the footwear company located in Sukabumi, West Java, especially for product upper shoes as figure 1.

Figure 1. Upper Shoes Product

2. LITERATURE REVIEW

There are several research and practice applications that have observed sustainable manufacturing processes, however few elaborate these three dimensions into one (Lozano, 2012). Some studies do not include the social dimension in the ongoing process (Gupta et al., 2018), while others do not include economic and environmental dimensions (Cao, Li, Yang, Liu, & Qu, 2018).

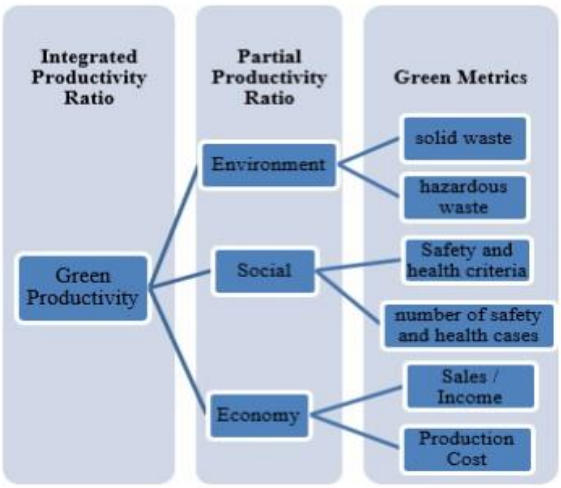

Figure 2. Research Framework

Figure 2 shows the framework of the conceptual thinking based on the literature review previously discussed. The researcher determines more detailed variables as a measure of productivity framework based on several previous studies which state that the calculation variables for environmental dimensions consist of residues / scrap produced which includes solid waste and

hazardous waste (Azevedo, Carvalho, Duarte, & Cruz-Machado, 2012; Chiarini, 2014; Gupta et al., 2018), while for the social dimension is the improvement of occupational health and safety (Hasibuan & Hidayati, 2018) and the economic dimension measured based on the element of profitability (Amrina & Firdaus, 2018). Green productivity values are obtained from multiplying environmental, social and economic variables.

3. RESEARCH METHODOLOGY

In this research, the footsteps of the sustainable productivity calculation is using the Green Productivity methodology developed by Asian Productivity Organization in 2009, where the steps are designed to increase productivity while maintaining and improving environmental performance (Astuti, Deoranto, & Aula, 2019).

a. Material

The research data were obtained from walkthrough survey that consist of:

a. Manufacturing process of upper shoes.
b. Monthly production result
c. Monthly selling price and quantity and total cost or expenses
d. Kinds of waste produce
e. Waste quantity and amount
f. Kinds of safety and health criteria
g. Safety and health cases and amount

b. Methods

This work is conducted by general steps of Green Productivity methodology as shown in figure 3, begins with a walkthrough survey and determine waste using process pollution output, then grasp the actual waste produced and set the productivity target, calculates the total process costs incurred and green productivity ratio.

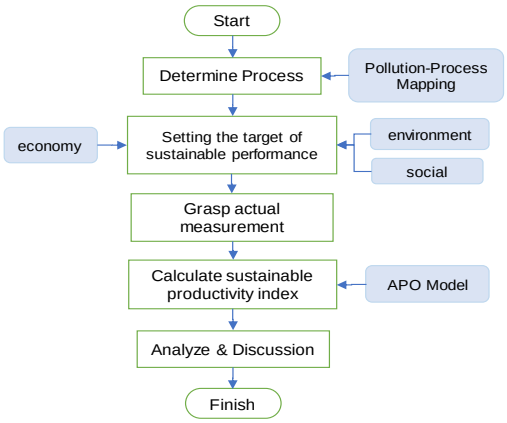

Figure 3. Research Flow Process

Finally, this research was closed with an analysis and discussion session.

4. RESULT AND DISCUSSION

A. Determine the process and identify waste for each green dimension

Figure 4 illustrates the sequence of making upper shoes and in any process, there is a residue that is harmful to the environment and the health of workers. The residue includes solid waste and hazardous waste. Hazardous waste is found in the laminating and assembling process with outsole, while solid waste is produced in the process of cutting and preparation. The two wastes will be measured at the next stage using gram units.

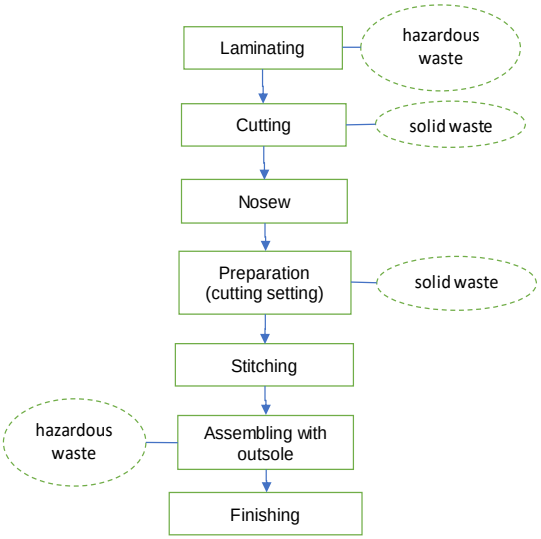

Figure 4. Process Pollution Mapping

B. Setting Target of Sustainability Performance

The next step is brainstorming to determine the target of sustainability performance index. As material for brainstorming, benchmarking of data on the value of solid waste, hazardous waste, employee health value, and productivity values are measured from income and total costs. The brainstorming process produces sustainability targets based on the best achievements of all subsidiaries so far, as below:

- The productivity ratio target obtained from income / costs is 89%.
- The target of solid waste (SW) = 199 gram/pair.
- The target of hazardous waste (HW) = 8 gram/pair.
- Employee health and safety target use environment and chemical first aid case (FAC) indicators and minor accident case (MAC), where FAC = 10 and MAC = 0.

C. Grasp the actual measurement

To measure the achievement of sustainable productivity, data collection on achievement of

productivity and environment impact is carried out during July - December 2018.

C.1. Total Productivity Target

To calculate Total Productivity, data on income and costs are needed in a period. Income is obtained from multiplying Selling Price (SP) and Selling Quantity (SQ), while costs are obtained from the sum of Material Costs (MC), Labor (LC), Energy (EC), Machinery (MachC), and other costs (GA) Then productivity ratio (PR):

$$PR = \frac{SP \; x \; SQ}{MC + LC + EC + MachC + GA} \ldots\ldots (1)$$

Calculation of total productivity in July-December is illustrated in table 1.

Table 1. Productivity Ratio as Economical Aspect

Criteria	Jul	Aug	Sept	Oct	Nov	Dec
Income (bio Rp.)	212,9	201,6	189,7	235,4	224,1	228,3
Expense (bio Rp.)	253,9	249,5	226,1	268,3	262,1	254,4
Productivity (%)	**83,9%**	**80,8%**	**83,9%**	**87,7%**	**85,5%**	**89,7%**

Based on the data in table 1 it is known that the average productivity of Jul – Dec 2018 is 85,3%.

C.2. Environment and Social Impact

Sustainability is seen from 3 aspects, namely economy, environment, and social. Economic aspects are measured from the total operational productivity obtained in 3.A., so as to complete the calculation of sustainability collected environment data (SW and HW) and social (safety and health working area). Example SW is natural leather, laminating foam, synthetic leather, etc. Examples of HW are based chemical, oil and lubricant solvents. While the safety and health working area is seen by FAC (such as eye, face, hand, fingers) and MAC (body and internal organs). Table 2 shows the environmental impact data and table 3 presents social impact.

Table 2. Environment Impact Amount

Criteria	Jul	Aug	Sept	Oct	Nov	Dec
Production (K pair)	1.089	1.040	1.065	1.129	1.044	1.091
Environment						
SW (gram/pairs)	216	220	224	208	202	192
SW (bio Rp.)	12,3	12,0	12,5	12,3	11,0	10,9
HW (gram/pairs)	9	11	8	8	8	8
HW (bio Rp.)	0,3	0,4	0,3	0,3	0,3	0,3
SW+HW (bio Rp.)	**12,6**	**12,4**	**12,8**	**12,6**	**11,3**	**11,2**

Table 3. Social Impact Amount

Criteria	Jul	Aug	Sept	Oct	Nov	Dec
FAC	20	10	8	14	12	7
MAC	2	2	0	0	1	0
Total Case	22	12	8	14	13	7
Amount (bio Rp.)	**0,006**	**0,004**	**0,0016**	**0,0028**	**0,0034**	**0,0014**

Based on the environment and social impact (ESI) formula:

ESI = SW + HW + FAC + MAC…… (2)

Table 4 shows the ESI values for July-December 2018. Based on the data in table 4, it is known that the average ESI is Rp.12,112 billion.

Table 4. ESI Amount (in bio Rp.)

Criteria	Jul	Aug	Sept	Oct	Nov	Dec
ESI Amount (bio Rp.)	**12,648**	**12,357**	**12,813**	**12,586**	**11,341**	**11,224**

D. Sustainable Productivity Index

After obtaining productivity figures and ESI impacts, the number of sustainable productivity index (SPI) can be calculated using the formula:

$$SPI = \frac{PR\ 2}{PR\ 1} \; x \; \frac{ESI\ 1}{ESI\ 2} \ldots\ldots\ldots\ldots\ldots (3)$$

Table 5 shows the SPI movement from August - December 2018.

Table 5. Sustainable Productivity Index (SPI)

Criteria	Aug	Sept	Oct	Nov	Dec
Productivity Index	0,96	1,04	1,05	0,97	1,05
ESI Index	1,02	0,96	1,02	1,11	1,01
SPI	**0,99**	**1,00**	**1,07**	**1,08**	**1,06**

Example of SPI calculation in Table 5 for period August 2018 were obtained from 80.8% / 83.9% x 12,648 / 12,357 = 0,99.

E. Analysis and Improvement Activities

In the application of sustainable productivity management, commitment is needed to determine challenge sustainable productivity performance. In the case of the footwear company, the target is not conservatively based on the average achievement. But the target was set based on the best achievement ever from all the subsidiaries. This is intended as a learning process and the growth of the company itself, where the achievement of a condition is based on scientific and replicable methods, and not just a coincidence. And this is evidenced by the achievement of a step by step target of sustainable performance, both economic performance, environment and social.

The achievement of each performance indicator affects the achievement of the overall sustainability improvement index. If the economic index is achieved but the social index environment is not achieved, the sustainability improvement index will have a value of ≤ 1. This phenomenon is shown in September, where the economic index has increased, but unfortunately the environment-social index has decreased due to the increasing amount of solid

waste produced. As a result, the SPI value becomes only 1.0.

Conversely, if the economic index decreases, but the social index environment increases, it can have an impact on the sustainability performance index. For example, in November, there was a decrease in the economic index by 3%, but this decline could be closed by an increase in the social environment index by 11% due to a decrease in the amount of solid waste, so that the index's productivity sustainability would increase by 8%. The most ideal condition is if the overall index has increased as well as in August, October and December.

To improve the sustainability index, some 3R (reduce, reuse, recycle) activities are proposed, such as:

A. waste reduction, consisting of reduction of scrap with cutting management (budomari concept) and modification of cutting dies,

b. Waste re-used, covering reuse of the contaminated rig by washing.

c. waste recycling, including the development of business cooperation with craftsmen to re-used materials such as leather, foam and textiles for pillow key chains, ID card hangers, etc. such as figure 5.

No	Type of Scrap	Product Utilization
1	Leather Scrap	Keychain
		Identity Card holder
2	Foam and Textile Scrap	Pillow

Figure 5. Utilization of Material Scrap

The 3R activities have been carried out in December 2018 - March 2019, with economic productivity results and ESI values as shown in table 6. The improvement activities carried out successfully stabilized the productivity ratio at 88.6% - 89.7%, SW values in the range 191.8 - 199.8 gram / pairs, HW values range from 7.6 - 8.5 gram / pairs, FAC on level 7 - 11 cases and MAC 0 cases.

Table 6. Economic Productivity and ESI December 2018 - March 2019

Criteria	Dec	Jan	Feb	Mar
Productivity (%)	89,7%	88,6%	89,2%	88,9%
ESI Amount (bio Rp.)	11,224	12,354	10,556	10,974
SW (gr/pairs)	191,8	199,8	197,6	194,3
HW (gr/pairs)	7,6	8,5	8,3	7,8
FAC (case)	7	11	10	8
MAC (case)	-	-	-	-
Productivity Index		0,99	1,01	1,00
ESI Index		0,91	1,17	0,96
SPI		**0,90**	**1,18**	**0,96**

While the achievement of targets in each sustainability indicator (productivity, SW, HW, FAC and MAC) is shown in the table by comparing the average data from July to November 2018 with December 2018 - March 2019 data and targets set by the company.

Table 7. Comparison of Data on Sustainability vs. Target Criteria

Criteria	Ave Jul-Nov '18	Ave Dec'18 - Mar'19	Target	Achieve-ment Status
Productivity (%)	**84,43%**	**89,1%**	**89,0%**	**O**
SW (gr/pairs)	214,0	195,9	199,0	O
HW (gr/pairs)	9,1	8,1	8,0	△
FAC (case)	13	9	10	O
MAC (case)	1	-	-	O

O = achieved, △ = nearly achieved

It can be seen from table 7 that most of the sustainability criteria are achieved, except for hazardous waste which still deviates from the target of 0.1 gram / pairs.

CONCLUSION

Sustainability management from a footwear company is seen from three dimensions of green manufacturing, namely economic-environmental-social. The economic dimension is measured by the criteria of income productivity ratio versus cost, while the environmental dimension is evaluated by criteria of the amount of solid and hazardous waste produced, and the social dimension seen from the criteria of occupational health and safety in the form of cases of first aid and minor accidents due to hazardous environments. To get a sustainable productivity index, the three dimensions are combined with calculations.

Based on data from July to November 2018, the value of sustainable productivity index looks to continue to increase but when viewed from each performance criteria it has not yet reached the target. For this reason, 3R improvement activities (reduce, re-use, cycle) are carried out, such as cutting management, modification of cutting dies, re-use of contamination rigs, and recycle scrap. The

improvement activity successfully achieved the target with an average productivity ratio of 89.1%, 195.9 gram / pairs of solid waste, first aid case 9 cases and zero minor accident (based on December 2018 – March 2019 result). While hazardous waste is still behind the target of 0.1 gram / pairs.

This research still has fixable weaknesses as opportunity to be developed by future research. First, in this study the weight of each dimension of sustainability is the same, in other industries it can be different. Second, in this study it has not considered the wastage carried out by humans and machines. Researchers can investigate more about those weaknesses.

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