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Analysis of Lean and Green Drivers for Sustainable Cosmetics SMIs Using Interpretive Structural Modelling (ISM)

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ABSTRACT

This study aims to identify the lever integration factors of lean and green in achieving sustainable Small and Medium Industries (SMIs) cosmetics using Interpretive Structural Modelling (ISM). The sustainable development of Cosmetics SMI grouped into four dimensions, namely the dimensions of manufacturing operations and the economy as part of the lean principle, the environment, and social consciousness as indicators of the green concept. The four dimensions described into 17 lean and green trigger factors based on literature studies and interviews of 5 experts. This study explores the conceptual relationship between the seventeen drivers by using a questionnaire and modeling it in the form of an ISM hierarchy model. Based on MICMAC analysis, HR welfare factors influence elements of soundness level and encourage the performance of manufacturing operation and environment factors. In the end, the relationship between lean and green factors will increase the SMIs Cosmetics income in micro and national tax revenue in macro. This study also proposes four strategies to be carried out by the SMIs owner-manager to improve the performance of lean and green.

Key Words: *Lean, Green, Sustainability, Interpretive Structural Modelling (ISM), Cosmetics.*

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1. INTRODUCTION

Cosmetics is one of the fast-growing industries and occupies the second position in the 2015-2035 National Industrial Development Master Plan [1], where 95% of the industry players are from SMI [2]. The growth in the number of cosmetic SMI in Indonesia is inseparable from the increasing market demand for local cosmetic products. Euromonitor International surveyed the Indonesian cosmetics market and showed that there was a significant market growth of local cosmetic products after the economic crisis [3]. In 2018 the number of national cosmetics industries exceeded 760 companies, of which 95% came from the small and medium business sector [2].

The Ministry of Health records the number of cosmetic industries in 2018 is 525 industries with geographical distribution, mention that Java and Bali are the areas with the highest number of cosmetic SMI of 92%. On the island of Java alone, the number of cosmetic SMI in the provinces of West Java, East Java, and Jakarta has reached 63%. Whereas Java, especially Jakarta, West Java, and Banten, are provinces with environmental quality indexes to watch out for [4]. Based on surveys and measurements conducted by the Ministry of Environment and Forestry, the environmental quality index value of the three provinces is <60, far below the national environmental quality index of 71.67 in 2018 [5]. The Government of Indonesia evaluates company compliance and environmental performance through the Ministry of Environment Regulation No. 3 of 2014 [6]. Every company, without exception SMI, must comply with these regulations.

On the other hand, SMI in Indonesia also experience problems with quality and productivity. SMI tends to rely on profits in the short term without regard to quality and productivity [7], [8]. Data from the Asian Development Bank shows that the average productivity growth of SMI in 2009-2012 in Indonesia is only 4.9%, below Thailand (6.1%) and Malaysia (9.5%) [9]. On the other side, the Food and Drug Supervisory Agency establishes regulations on Goods Manufacturing Product (GMP) to maintain cosmetic quality standards to be on par with international standards. By maintaining the quality of the products produced, the Government hopes that Cosmetics SMI can increase the productivity and profitability of its business.

To maintain the performance of cosmetic SMI in order to remain productive, generate profits, and at the same time, be responsible for the environment and social welfare, the Cosmetics SMI owner-managers must understand what elements drive sustainable business. Then, they can decide what strategies improve their sustainable performance. This research aims to help the owners of Cosmetics SMI in determining the sustainable drivers and formulate strategies in achieving sustainable Cosmetics SMI.

The need for the cosmetics industry to have a sustainable manufacturing process is a fundamental requirement from customers, society, and Government. A sustainable manufacturing process is a process that integrates the principles of lean and green manufacturing, which pays attention to three pillars, namely environmental, social, and economic [10], [11]. The integration of lean and green manufacturing requires a detailed exploration of what factors influence long-term integration performance.

2. LITERATURE SURVEY

2.1. Integration Lean and Green Manufacturing

When viewed from the standpoint of science, the application of lean principles can overcome the difficulties faced by SMI in achieving productivity and quality. The lean concept was initially known as a manufacturing solution to achieve maximum added value through the identification of 8 types of waste generated by all activities that utilize resources and eliminating those wastes immediately from the manufacturing operation [12], [13], [14]. Waste elimination can contribute to the improvement in productivity and quality of the manufacturing process [15]. While increased productivity and quality will also contribute to profit growth [16]. On the other hand, green practice can resolve the difficulties related to its contribution to environmental and social. The concept of green responds to the demands and needs of the industry for the creation of a manufacturing process that is environmentally responsible, both from an environmental and social perspective and not just pursuing economic benefits alone [17], [18]. The goal of the green concept is to create a sustainable system through a triple bottom line, namely people, profit, and planet [19], [20], [21]. These three dimensions of a sustainable system create into criteria and measures of social, economic, and environmental performance [22], [23]. This research includes factors that are related to operational, economic, environmental, and social dimensions, as a manifestation of the integration of lean and green principals.

2.2 Lever Factors in Lean and Green Manufacturing Integration

The lean concept implemented in the company can improve company performance in various dimensions. Lean can directly strengthen the operational dimensions of manufacturing, with factors including product quality, productivity, and elimination of waste [24], [25]. Productivity includes the use of every owned resource to produce several products requested by the customer [26]. By strengthening the operational dimension, it will improve the performance of the microeconomic dimension, which includes costs (raw materials, labor, and support costs) and profits (revenue and selling price) of the company [27]. Improvement of the microeconomy will also contribute to the development of the macroeconomic dimension, including growth in regional income from industrial sectors [28], [29]. With the increase in regional income, it will affect the opportunity for the Government to get income for the development of the industrial sector. The Government could give the subsidy of capital assistance and some import facilities to the industry players. Lean practices can indirectly influence environmental and social performance positively [30], [31]. By eliminating waste, there will be efficiency in the consumption of resources. It will have an impact on reducing the amount of residue disposed to the environment. While social performance trigger to the development of human resources that can enhance the reputation of the company from a social perspective, through empowerment and education or training that can influence motivation and improve positive employee skills. Although it has an indirect impact on the environment and social environment, lean concept does not explicitly carry both dimensions.

Along with the demands for the establishment of an inclusive and sustainable industry, the lean concept began to integrate with the concept of green, which gave more intense attention to the environmental and social dimensions. There are several factors from the environmental dimension that must be considered, including the type and amount of material and energy resources used, the amount of pollution produced, the quality of the natural environment around the industry [32]. Hallam and Contretas (2016) add the power of green branding as one of the factors affecting green industries. While several factors that support the social dimension include HR management, social commitment, handling customer complaints, equality, and protection of human rights [32].

2.3. Interpretive Structural Modelling (ISM)

ISM is a methodology for mapping the structure of relationships of factors in complex systems [33]. ISM helps interpret the structure of the system in the form of relationships between elements of a system and presents it in the graphical form [34]. Some types of contextual relationships can be in the form of influence, helpers, contributions, interests, and drivers [35]. ISM allows researchers to use expert opinions based on various management techniques such as interviews, brainstorming, group discussions, and others in mapping the contextual relationships between factors [36]. In this study, researchers consulted with experts from Cosmetics SMI and association in identifying the nature of contextual relationships between factors.

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The ISM methodology introduces several terms. First is the SSIM or Structural Self Interaction Matrix. SSIM is a matrix that shows the relationship between factors that represent respondents' perceptions of goals. The interpretation process for SSIM filling consist of four relationships symbolized by V, A, X, and O. The explanation for the VAXO symbol is:
• The symbol V indicates that the X-factor influences the Y-factor.
• The symbol A indicates that the factor Y influences the factor X.
• The symbol X indicates that the X factor and the Y-factor influence each other
• The symbol O indicates that the factors X and Y do not affect each other

The second terminology in ISM is RM or Reachability Matrix. RM is a matrix that shows the change from SSIM symbol patterns to binary numbers. RM illustrates how strong driving power and dependent power are. The third is a revised matrix that uses the transitivity rule to correct SSIM values and get consistent values. This matrix compares the value of each SSIM cell with the rules if factor A influences factor B and factor B affects factor C, then factor C will also affect factor A. Fourth is a Micmac analysis which classifies the direct and latent relationship of the reachability matrix results into four quadrants [37], i.e.

1. Autonomous Quadrant I. The factors in this quadrant do not have the power of influence or dependence. They have no attachment to the system.
2. Quadrant II Dependent. In this quadrant, factors have a low influence strength but a high dependence on the system.
3. Quadrant III Linkage. The factors in this quadrant have a strong influence and dependence.
4. Quadrant IV Independent. This position shows high influence strength but low dependence.

3. RESEARCH METHODOLOGY

Figure 1 shows the research steps in this study.

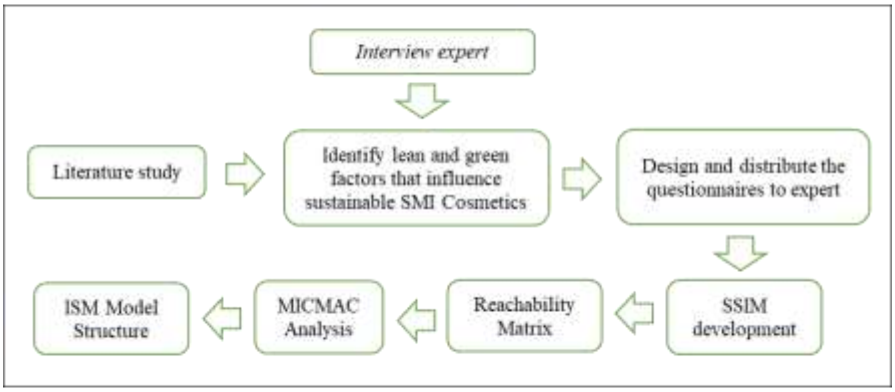

Figure 1. Research Steps Using the ISM Methodology

Figure 1 shows that in this study, researchers used literature and expert interviews to identify lean and green leverage factors to create a sustainable Cosmetic SMI. This study involved five experts in the field of cosmetics. The respondents' positions and years of service indicate the expertise of them. All experts have work experience of more than 20 years. Three of them are the leaders and owners, and two of them are operations managers. Then the researchers designed a questionnaire based on identifying the lever integration factors of lean and green in the form of a matrix table and distributing them to the experts.

4. RESULT AND DISCUSSION

4.1. Factors Identification

Based on literature studies and expert interviews, the researchers formulated lean and green drivers to achieve a sustainable Cosmetic SMI, as shown in Table 1. This study considers four dimensions, namely manufacturing, economic, environmental, and social dimensions. These four dimensions support the achievement of sustainable business. This research divides the manufacturing dimension into seven main factors related to operational excellence indicators. The Economic Dimension consists of five supporting factors that can create a stable corporate profit and government revenue. The Environmental Dimension includes three factors that represent the assessment of the SMI responsibility indicators for environmental sustainability. Furthermore, the social dimension includes two factors that show the contribution of SMI to the health and well-being of HR who mostly live around SMI.

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Table 1. Lean and Green Integration Driver

Dimension	No	Factors	Definition	Reference
Manufacturing	F1	Production Facility	Availability of production facilities and equipment in compliance with regulations	[32]
	F2	Quality Improvement	Product quality improvement activities throughout the production process	[20], [23]
	F3	Production Waste	The amount of waste produced, which includes seven types of waste	[23]
	F4	Product Design/Formulation	The material formulation used in cosmetic products	[19]
	F5	HR Capability	The ability or skills of human resources	[19]
	F6	Use of Resources	Total use of production resources	[32]
	F7	Productivity Control	Production controls that ensure output values are greater than inputs (resources)	[20], [23]
Economy	F8	Manufacturing Cost	The number of expenses incurred by all manufacturing process	[24], [27]
	F9	Sales revenue	The amount of revenue from the sale of cosmetic products	[24], [27]
	F10	Company profitability	The profit obtained is the difference between sales value and costs	[24], [27]
	F11	Tax Paid	The amount of tax paid to the Government	[38]
	F12	Government Subsidies	Capital assistance provided by the Government to small and medium industries	[28]
Environment	F13	Environmental Impact	Emission in the type of solid, liquid, and others	[29]
	F14	Emission/Residual Reduction Program	Company activities to reduce the amount of emission	[30]
	F15	Green Brand Certification	Green product certification obtained by all cosmetic variants produced	[23]
Social	F16	HR Health and Safety	Number of human resources who are sick or injured as a result of work	[23]
	F17	HR Wealth	The average income of cosmetic workers (including incentives)	[23]

4.2. SSIM Development

In this section, the researcher processes the questionnaire data filled by the five experts using Exsimpro - ISM 2.0 software. Table 2 shows the aggregate conversion data from the answers of the five experts in the form of VAXO tables.

Table 2. Aggregate Value of Expert Questionnaire

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17
F1		X	A	O	A	V	X	A	O	V	O	A	X	X	V	X	V
F2			X	X	V	X	X	A	A	A	A	V	X	X	A	O	A
F3				X	V	X	A	A	O	X	O	A	V	A	V	O	O
F4					A	V	A	A	V	V	V	A	X	X	V	O	O
F5						V	A	A	V	V	V	A	A	A	O	A	X
F6							A	A	O	V	V	O	V	A	V	V	O
F7								A	O	V	V	A	A	A	O	A	A
F8									O	A	O	A	A	A	O	A	A
F9										V	V	V	A	A	A	O	O
F10											A	V	A	A	A	A	A
F11												X	A	A	O	O	O
F12													O	V	O	O	O
F13														V	V	V	O
F14															V	V	O
F15																A	O
F16																	A
F17																	

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The aggregate decision making of the five experts considers two conditions. First is the highest number of symbols selected. Second is if the numbers are the same, then the decision making is based on the priority of the VAXO symbol. The priority order is V at the highest place, followed by A, X, and O.

4.3. Reachability Matrix

At this stage, the researcher transforms the SSIM table into a first Reachability matrix form by changing VAXO to numbers 1 and 0. The symbol V will change the row cell to 1, and the column cell to 0. For example, the relationships (F2, F1) in Table 2 show V, and then the reachability matrix F2 is one, and F1 is zero or mathematically equal (1.0). Table 3 maps the reachability matrix showing the relationships between factors in sustainable SMI.

Table 3. Reachability Matrix

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17
F1	1	1	0	0	0	1	1	0	0	1	0	0	1	1	1	1	1
F2	1	1	1	1	1	1	1	0	0	0	0	1	1	1	0	0	0
F3	1	1	1	1	1	1	0	0	0	1	0	0	1	0	1	0	0
F4	0	1	1	1	0	1	0	0	1	1	1	0	1	1	1	0	0
F5	1	0	0	1	1	1	0	0	1	1	1	0	0	0	0	0	1
F6	0	1	1	0	0	1	0	0	0	1	1	0	1	0	1	1	0
F7	1	1	1	1	1	1	1	0	0	1	1	0	0	0	0	0	0
F8	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
F9	0	1	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0
F10	0	1	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0
F11	0	1	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0
F12	1	0	1	1	1	0	1	1	0	0	1	1	0	1	0	0	0
F13	1	1	0	1	1	0	1	1	1	1	1	0	1	1	1	1	1
F14	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1
F15	0	1	0	0	0	0	0	0	1	1	0	0	0	0	1	1	0
F16	1	0	0	0	1	0	1	1	0	1	0	0	0	0	1	1	1
F17	0	1	0	0	1	0	1	1	0	1	0	0	0	0	1	1	1

The next step is to correct the initial reachability matrix using the transitivity rule. This rule refers to the principle of the circle of cause and effect. If X affects Y and Y affects Z, then X must affect Z. The driving power (DP) and Dependence (D) values indicate the results of the classification of factors from processing the data. Then, table 4 map the final Reachability matrix.

Table 4. Final Matrix

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17	DP	R
F1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	17	1
F2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	17	1
F3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	17	1
F4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	16	2
F5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	17	1
F6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	16	2
F7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	17	1
F8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	17	1
F9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	14	4
F10	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	0	14	4
F11	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	0	0	13	5
F12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	17	1
F13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	17	1
F14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	17	1

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F15	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	15	3
F16	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	17	1
F17	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	17	1
D	17	17	17	17	17	17	17	17	15	17	17	17	17	17	15	13	11		
L	1	1	1	1	1	1	1	1	2	1	1	1	1	1	2	3	4		

Table 5 produces driving power (DP) and dependency (D) values, then lists ranking (R) and level (L), which shows the grouping of factors. The ranking and level order base on the amount of driving power and dependency of each factor. The results of the final reachability matrix affect the quadrant mapping in the MICMAC analysis and the structure of the ISM model.

4.4. MICMAC Analysis and ISM Model Structure

MICMAC analysis is an analysis technique used to determine the relationship between driving power and dependence power in four quadrants. Based on the results of the questionnaire transferred in the reachability matrix in table 5, all factors have driving power and dependencies of more than 9. This score indicates that all factors are in the second quadrant (zone linkage) with driving power and strong dependencies. Figure 3 shows the mapping of MICMAC analysis in this study.

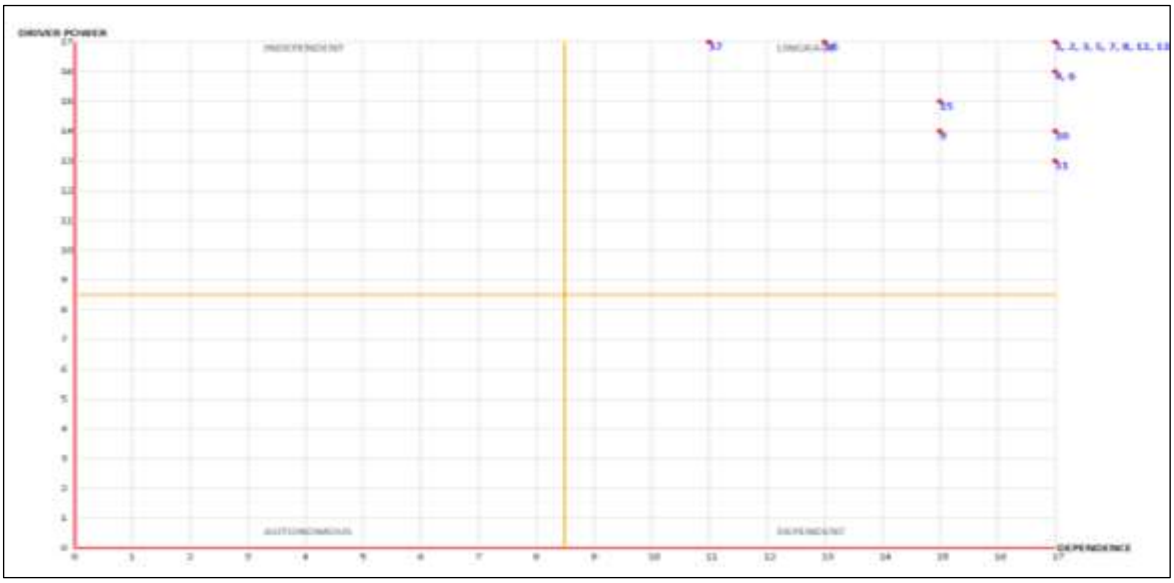

Figure 3. Diagram of Relationship Between Factors Results of MICMAC Analysis

Based on Figure 3, the 17th factor, namely HR health, has a dependency value of 11 and driving power 17. This score places HR health at point (11.17) on the MICMAC chart. While the company tax paid produces a dependency value of 17, but the lowest driving power is 13. These results place the company tax paid at point (17.13).

By mapping the sequence and position of each factor in the reachability table and MICMAC graph, the researcher can structure the ISM model, as shown in Figure 4. The ISM model is a structural model in the form of canonical diagrams. This model regulates the order of relationships of each factor.

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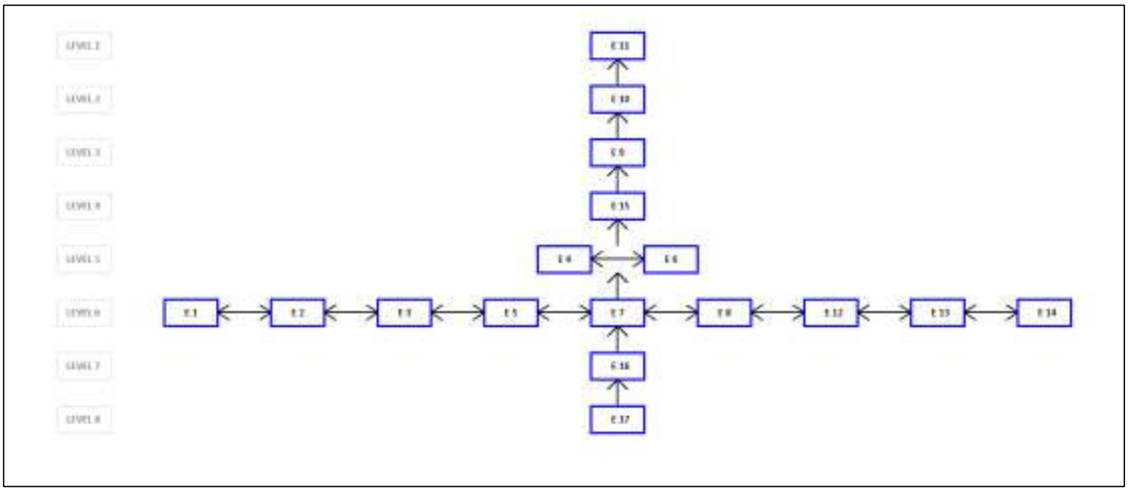

Figure 4. ISM Model in the form of Structural Diagrams

Based on Figure 4, Cosmetics SMI should prioritize health factors (E17) and HR welfare (E16) to show its concern for sustainable business. These two factors are at level 8 and level 7. Both encourage the performance of lean factors (E1, E2, E3, E5, E7, E8, and E12) and green (E13 and E 14) at level 6. The integration of lean factors and green factors will influence product innovation in the form of formula and design modification (E4) and have an impact on the efficient use of production resources (E6) at level 5. Both factors encourage the acquisition of green brand certification (E15) at level 4 and provide opportunities for Cosmetics SMI to increase product sales revenue (E9) at level 3. Increased revenue will encourage micro profits (E10) at level 2 and continue to increase tax payments to the country at a macro level (E11) at level 1. By knowing these driving factors, the SMI's owner-manager can determine the right manufacturing strategy to control their performance towards achieving a sustainable Cosmetics SMI.s

Owner-managers can plan some strategies such as:

- Improving product quality and reducing waste in the use of production resources through the implementation of lean and green techniques. Cosmetics SMI can open research for lecturers and students who are willing to help implement these techniques.
- Selection of environmentally friendly material formulations, which are safe for the health of workers, as well as for their consumers. Cosmetics SMI can work with suppliers for the accuracy of material selection, both in terms of specifications and price.
- Check employee health regularly in cooperation with the local health center.
- Evaluate the resulting environmental impact control program and report it to the Government to get a green label on its cosmetic products.

By implementing the proposed strategy, the owner-manager can achieve a sustainable Cosmetics SMI performance.

5. CONCLUSION

Lean and green practices at Cosmetics SMI aim to create sustainable businesses, which not only encourage increased profits but also demonstrate environmental and social responsibility. This study identifies the factors that trigger the achievement of sustainable SMI and explores the relationships between these factors. This research helps open the insight of the owner-manager in understanding complex system problems by mapping the factors that trigger lean and green by linking driving and dependency power. Based on a questionnaire of 5 experts, the researcher processed the 17 trigger factors using the ISM method. A review of the results of the MICMAC analysis shows that all factors are in the linkage quadrant, which indicates driving strength and dependence power. The results of data processing showed the rank of 17 factors in 8 levels. HR health becomes a factor with the most potent driving power, thus placing it at level 8. HR health encourages the performance of factors at its top level. The tax value paid by the company becomes a factor with the strong dependency and places it at level 1. The factor is highly dependent on the performance of the factors below it. Cosmetic SMI Owner-manager can implement several strategies to improve the performance of each factor. This research proposes four strategies. First is the implementation of lean and green manufacturing techniques to improve quality and eliminate waste in the use of production resources. Second is the choice of environmentally friendly material formulations. Third, employee health checks. Finally, the fourth is the evaluation of environmental impact control programs and reporting to the Government. By carrying out this strategy, the owner-manager can achieve a sustainable Cosmetics SMI.

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