Enablers and Barriers of Implementing Circular Economy for Micro and Small Manufacturing Enterprises (M-MSEs) in West Sumatera

Efni Cerya*[ID], Idris Idris[ID], Joan Marta[ID]

Doctoral Program of Environmental and Development Studies, Faculty of Economics and Business, Universitas Negeri Padang, Padang 25132, Indonesia

Corresponding Author Email: efnicerya@fe.unp.ac.id

ABSTRACT

This study aims to analyze the barriers and enablers to implementing a circular economy (CE) at M-MSEs in West Sumatera, identify M-MSEs in West Sumatera that can implement a circular economy, and identify the influencing factors. Questionnaire were distributed to 110 respondents from several M-MSEs in West Sumatera, Indonesia, from March to September 2022. Descriptive analysis and Pearson Correlation was employed in data analysis, and result showed that several CE practices have been implemented by M-MSEs in West Sumatra, thus supporting the notion that CE implies a systemic approach to increasing firm value. In particular, resource-efficient production processes have been widely implemented, namely 36%; this achievement is undoubtedly relatively high compared to the rarity of M-MSEs, which use residual materials in the production process. The most significant barrier to implementing CE that employers feel is the lack of financial support in implementing CE. However, companies that have started implementing CE see it as a business enabler rather than a cost, so CE can be an added value and innovation of the products they produce.

1. INTRODUCTION

In the 21st century, population growth, consumerism, and a linear approach to industrialization have rapidly increased waste production due to heightened human activities [1-3]. This situation has prompted governmental and non-governmental organizations to give greater consideration to the need to shift from traditional practices to advanced technologies and environmentally friendly approaches.

The Government of Indonesia has strengthened its commitment and efforts to address economic, social, and environmental problems by incorporating the circular economy (CE) into its development vision and strategy. To prevent significant environmental risks and increase long-term human well-being for future generations, a development model has been adopted. This model seeks to separate economic and social growth from the use of natural resources (resource decoupling) and from environmental degradation (impact decoupling). A The model no longer follows the "take-make-waste" logic of a linear economy, but instead promotes a circular cycle of "reduce, reuse, and recycle" [4].

The circular economy is a global economic model aimed at minimizing the consumption of limited resources by focusing on the intelligent design of materials, products, and systems [5, 6]. It is seen as a new business model expected to lead to more sustainable development and a harmonious society [7-9].

The circular economy promotes a more appropriate [10] and environmentally friendly use of resources which is characterized by new business models and innovative job opportunities, as well as by increased welfare and equity among generations in terms of use and access to resources [11, 12].

Circular economy practices utilize available resources effectively and efficiently with the main objective of producing zero waste. The adoption of CE can promote higher green economic growth than "business as usual" scenarios (Business as Usual), by designing production systems that require fewer resources, ensuring raw materials are extracted and used as efficiently and for as long as possible, and using products and services more efficiently than current practice.

The circular economy seeks to generate economic growth while maintaining the value of products, materials, and resources within the economy for as long as possible, thus minimizing the social and environmental damage caused by the old linear economic approach [13, 14]. CE is not only about better waste management with more recycling, but includes a wide range of interventions across all sectors of the economy. CE activities focus on the 5Rs, namely Reduce, Reuse, Recycle, Refurbish, and Renew.

The circular economy is expected to be able to increase industry competitive advantage both on a global, national and local scale by using resources wisely [15, 16]. In Indonesia, the circular economy concept is adopted as an effort to maximize mutual benefits between the economy and the environment, particularly in the five main economic sectors (food and beverages, textiles, construction, wholesale and retail trade, as well as electrical and electronic equipment). These five sectors represent a third of Indonesia's GDP and employed more than 43 million people in 2019. The current practices of these sectors are still inefficient and generate a lot of waste. The following is data related to the waste generated by the five sectors in 2021 and the projected increase in waste in 2030.

Table 1. Industrial sector waste in indonesia in 2021 and the projected increase in waste in 2030 in the "business as usual" scenario

Industrial Sector	Waste in 2021 (Million Tonnes)	Projected Waste Increase in 2030 (%)
Food and beverage	57.4	54%
Textile	2.3	70%
Construction	29.0	82%
Wholesale & retail trade	5.4	40%
Electrical & electronic equipment	1.8	39%

Table 1 shows the Industrial Sector Waste in Indonesia in 2021 and the Projected Increase in Waste in 2030 in the "Business as Usual" Scenario. The food & beverage sector produces the most waste among other sectors in 2021, namely 57.4 million tons. Meanwhile, the construction sector is the highest sector with a projected increase in waste in 2030 of 82%. The projected increase in waste in 2030 is a projection using the "Business as Usual" scenario. To reduce waste production and increase its recycling rate, it is necessary to implement a circular economy in Indonesia. The Ministry of National Development Planning/Bappenas notes that the circular economy can reduce waste by up to 50% in 2030 compared to the "Business as Usual" scenario.

From the problems described above, it is undeniable that M-MSEs have contributed to environmental pollution due to both operational and non-operational activities [17]. This negative impact can take the form of natural resource and water waste, and land or air pollution caused by solid or liquid waste [18, 19]. To maintain environmental balance in every business activity, starting from input to output, IMK in both developed and developing countries are beginning to transition towards a circular economy.

This research was conducted to provide a better understanding of CE implementation in West Sumatra. To address gaps in previous research, this study focuses more on the application of CE at the M-MSE level. Many studies have examined how the circular economy is implemented at the macro and medium levels. However, there are still very few studies discussing circular economy readiness for M-MSEs, especially in developing countries. The practice of the circular economy in M-MSEs in developing countries can be considered to be still in the embryonic stage, both academically and practically.

For more in-depth research results, this study also measures the opportunities and obstacles M-MSEs face when implementing CE in their economic activities. By understanding these opportunities and constraints, we can measure the correlation of these factors with the CE practices that have already been implemented.

The results of this study will provide theoretical and practical implications in terms of implementing CE at M-MSEs. The theoretical contributions proposed in this study are: 1) Analysis of CE implementation at M-MSEs, 2) Analysis of opportunities and obstacles to CE implementation in M-MSEs in West Sumatra, and 3) Correlation analysis of opportunities, barriers, and implementation of CE in M-MSEs in West Sumatra. This research will also provide a practical contribution to the government as a policy maker regarding economic activities of M-MSEs, and further promote the application of CE as an effort towards environment-based sustainable development.

2. LITERATURE REVIEW

The circular economy combines economic, environmental, technological, and social issues [20]. In a circular process, a limited number of resources are extracted from the environment based on the need for production and are used more efficiently and sustainably during the production process. Essentially, in a circular economy, residual quantities lost in the production process are recovered and recycled to be reused and generate output. The circular economy is a regenerative method that views the production process as a system of organisms producing nutrients (wastes) that can be reused.

The circular economy (CE) is defined as a global economic model for minimizing the consumption of finite resources by focusing on the intelligent design of materials, products, and systems. The circular economy is a novel concept that utilizes a closed-loop approach that can drastically change the existing ways of manufacturing, production, and consumption. By introducing and applying environmentally friendly and sustainable production techniques, the circular economy will create a transformative and wise global market that ensures value creation and economic prosperity for every country. The circular economy approach differs from the traditional linear model, which is an economic system with the primary objective of making the most sustainable use of resources by increasing efficiency and reducing waste. It aims to create value through efficient resource use and a drastic transformation of production and consumption techniques [21].

CE is a set of conceptual responses to inefficient industrial systems and has various definitions and interpretations stemming from its conceptual evolution spanning multiple disciplines [22]. The majority of circular economy literature emphasizes production benefits [11], value creation capabilities [23], and social benefits, which include economic models based on renewable energy and resource efficiency [24]. The circular economy has the ability to bring significant changes to everyday human life [25].

In practice, CE has been implemented through a range of policy, business, and societal responses to ensure materials are stored at the highest possible value through strategies such as reduction, reuse, and recycling to close, slow down, and narrow material loops [26]. The literature establishes that CE can be explored at three broad levels: (1) micro, (2) meso, and (3) macro [27]. The volume and scope of literature vary between these levels [28]. Currently, there is no adequate range of studies exploring CE adoption at the individual micro-organizational level.

CE can lead to economic, environmental, or social benefits. Environmental benefits related to the impact of industrial processes on ecosystem stability, for example, reduced greenhouse gas emissions or reduced consumption of energy and resources. Economic benefits are divided into economic benefits for customers and economic benefits for the supply chain. Customers can reach the financial benefit when savings can be achieved in the use phase thanks to more energy-efficient products. Supply chains can benefit from CE by paying less for materials and saving on demolition and stockpiling costs.

In addition, innovative or more sustainable product offerings can improve brand image, enhance supply chain competitiveness, and help comply with carbon tax-based legal frameworks. Social benefits occur when CE brings net benefits to society, such as growth in employment opportunities,

improvement in the quality of employment, and promotion of equality.

Despite the seemingly endless benefits of a circular economy, transforming in that direction from the existing system will be highly challenging. In addition to developing and less developed regions, many developed countries lack infrastructure and technological competitiveness to effectively transition to a circular economy system. Many industries in developed countries are not well equipped to implement and change to the circular model.

According to Lacy and Rutqvist [29], most companies' strategic and operational designs are deeply rooted in the traditional linear model, making it difficult and complicated for them to shift to the circular model. However, many countries will significantly benefit from the transformation if they can transit successfully. Friedl and Reichl [30] suggested that an effective transition policy is needed beforehand to minimize potential failures and make the transition beneficial for all countries. Besides reducing cost and price risks, implementing a circular economy will require significant investments that businesses may not be prepared for. While mature companies may find it affordable to finance such massive transformations, companies in the early stages and life cycle growth will undoubtedly find it difficult to support and cope with these changes.

3. METHODOLOGY

The type of method in this study is quantitative research methods. The population in this study is Micro and Small Manufacturing Enterprises (M-MSEs) in West Sumatra. Non-probability sampling was carried out using a formula. Thus, 110 respondents were selected as samples whose characteristics of owner and business are described in Tables 2 and 3.

This research was collected over five months, from March to September 2022. Data collection techniques used in this study is questionnaires and data analysis techniques used are descriptive analysis and Pearson correlation.

The following indicators are used to measure the extent of CE implementation, obstacles and opportunities in implementing CE at M-MSEs. Table 4 shows the indicator of CE pratices, Table 5 shows the barriers to implementing CE in M-MSEs, and Table 6 shows opportunities to implementing CE in M-MSEs.

Table 2. Respondent profiles

Characteristics	Option	Total %
Gender	Female	60
	Male	40
Age	<=20 years old	2
	21-30 years old	25
	31-40 years old	33
	41-50 years old	25
	>50 years old	15
Last education	Master degrees	4
	Bachelor degrees	48
	Senior high school	40
	Junior high school	7
	Elementary school	1
Participating in training	Management	16
	Technical skills	24
	Marketing	38
	Environmental impact analysis	4
	Never participated	18

Table 3. Business profiles

Characteristics	Option	Total %
M-MSEs sector	Food and beverage	75
	Services and trade	7
	Manufacturing	15
	Fashion	1
	Creative industry	2
Business ownership	family-owned	69
	Not announced	25
	Recorded	3
	Broad share	2
	Majority capital held by family	1
Characteristics of business	Seasonal	14
	Not seasonal	86
Business license status	Business license status	46
	Special permit status from agencies	43
	No	11
Ownership of national/international scale production process certificate	Indonesian national standard (SNI)	8
	Other national certifications (HALAL, MUI, PLJK, etc.)	60
	Additional certifications	32

Table 4. CE practices

No	CE Practices
1	Facilities/infrastructure to support business activities to implement circular economy practices
2	Human resources (HR) capable of implementing environmentally friendly production processes
3	Prepared sufficient funds to implement circular economy processes
4	Use organic raw materials
5	Uses environmentally friendly materials in the product manufacturing process
6	Biodegradable materials for packaging
7	Separate waste collection system
8	The impact of the production process on the environment is carried out regularly
9	The raw materials used are residues from other production processes
10	Resource-saving production process
11	Reuse of waste water and/or rain water

Table 5. Barriers to implementing CE in M-MSEs

No	Barriers
1	Lack of financial support
2	Lack of government/legislative support to encourage green business (providing funding opportunities, training, laws, regulations, etc.)
3	Lack of proper technology
4	Lack of information about the benefits of circular economy and environmental legislation
5	Lack of financial resources
6	Lack of consumer interest in the environment
7	Lack of support from public institutions
8	Lack of qualified professionals in environmental management
9	Lack of commitment from organizational leaders

Table 6. Opportunities to implementing CE in M-MSEs

No	Enablers
1	Prestige increase
2	Cost reduction and financial profitability
3	Local environmental restoration
4	Business continuity

4. RESULTS AND DISCUSSION

4.1 Result

4.1.1 Knowledge of business owners regarding environmentally friendly production processes

As shown in Table 7, these results indicate that business owners' knowledge regarding environmentally friendly production processes includes understanding what an environmentally friendly production process is, understanding the impact of implementing or not implementing an environmentally friendly production process, and understanding government regulations regarding the implementation of an environmentally friendly production process.

Table 7. Knowledge of business owners regarding environmentally friendly production processes

No	Questions	Mean	St. Dev	N
1	The owner has understood what an environmentally friendly production process is	4.5	2.2	110
2	The owner understands the impact of implementing or not implementing environmentally friendly production processes	4.4	2.1	110
3	The owner understands the infrastructure/technology needed to implement an environmentally friendly production process	4.3	2	110
4	To increase my understanding of environmentally friendly production, the owner attend environmental-related training	4.2	2	10
5	The owner understands government regulations regarding the application of environmentally friendly production processes	4.4	2	110

4.1.2 Implementation of M-MSEs environmentally friendly practices

Figure 1 shows the survey results related to implementing environmentally friendly practices by M-MSEs. Based on these results, it is known that the most environmentally friendly practices implemented are resource-efficient production processes (36%), followed by the application of a separate waste collection system (34%) and the use of environmentally friendly raw materials in the product manufacturing process (32%). Mura in his research also found that the most widely adopted CE practice in Spanish M-MSEs was separate waste collection, which was carried out by 84% of the companies surveyed and followed by the reuse of packaging [31]. Practices that M-MSEs want to implement in the next 2 years include the regular impact of the production process on the environment (56%), followed by the preparation of sufficient funds to implement environmentally friendly production processes (52%), and the preparation of supporting facilities/infrastructure for business activities to implementing environmentally friendly practices (52%). Meanwhile, circular economy practices that are not implemented, namely, the raw materials used, are residues from other production processes (29%).
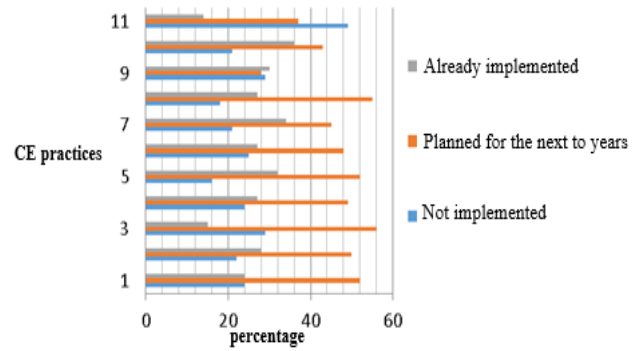
Figure 1. Implementation of M-MSEs environmental friendly practices

4.1.3 Barrieres to the implementation of environmentally friendly M-MSEs

Table 8 below shows the obstacles to implementing environmentally friendly M-MSEs. Based on the survey results, it is known that a lack of financial resources is the main obstacle to implementing circular economy practices, followed by a lack of financial support, a lack of support from public institutions, and a lack of consumer interest in the environment. Meanwhile, the most minor considered obstacles are the lack of government/legislative support to encourage environmentally friendly businesses (through funding opportunities, training, laws, regulations, etc.). Rizos et al. [32] in his research stated that more than 20% of SMEs reported difficulties in attracting the necessary funds from traditional banks to implement more sustainable measures within the company, to invest in the development of new environmentally friendly goods and services, or to finance the purchase of low-cost equipment resource.

Table 8. Barriers to implementing environmentally friendly M-MSEs

No	Barriers	Mean	St. Dev	N
1	Lack of financial support	4.4	2.1	110
2	Lack of government/legislative support to encourage green business (providing funding opportunities, training, laws, regulations, etc.)	4	2	110
3	Lack of proper technology	4.1	1.9	110
4	Lack of information about the benefits of circular economy and environmental legislation	4.1	1.9	110
5	Lack of financial resources	4.5	1.9	110
6	Lack of consumer interest in the environment	4.3	1.9	110
7	Lack of support from public institutions	4.3	1.9	110
8	Lack of qualified professionals in environmental management	4.2	2	110
9	Lack of commitment from organizational leaders	4.1	2	110

4.1.4 Enablers for implementing environmentally friendly M-MSEs

Table 9 shows that the most powerful factors that become enablers for implementing environmentally friendly M-MSEs are business continuity and local environmental restoration. Meanwhile, the least considered enablers are increasing prestige and reducing costs and financial profitability.

Table 9. Enablers for implementing environmentally friendly M-MSEs

No	Enablers	Mean	St. Dev	N
1	Prestige increase	4.3	1.9	110
2	Cost reduction and financial profitability	4.3	1.8	110
3	Local environmental restoration	4.5	1.8	110
4	Business continuity	4.9	1.8	110

4.1.5 Correlation analysis results

The results of the correlation analysis are shown in Table 10. The table shows the correlation between the implementation of circular economy practices and the obstacles and opportunities in their performance. The decision-making on the Pearson correlation is as follows:

If the significance value is<0.05, then it is correlated.

If the significant value is>0.05, then it is not correlated.

The results show that infrastructure supporting business activities to implement environmentally friendly practices is correlated with all enablers for implementing environmentally friendly M-MSEs, namely increasing prestige, reducing costs and financial profitability, and business sustainability. In addition, organic raw materials, waste management, and residual materials correlate with all enablers for implementing environmentally friendly M-MSEs.

Table 10. Correlation analysis between circular economy practice, barriers, and enablers

	B1	B2	B3	B4	B5	B6	B7	B8	B9	E1	E2	E3	E4
[1]	0.602	0.416	0.543	0.547	0.334	0.552	0.985	0.862	0.591	0.044	0.012	0.001	0.013
[2]	0.868	0.586	0.900	0.502	0.177	0.932	0.956	0.915	0.281	0.002	0.002	0.010	0.060
[3]	0.771	0.900	0.523	0.208	0.327	0.878	0.904	0.888	0.476	0.170	0.065	0.140	0.308
[4]	0.181	0.165	0.076	0.039	0.428	0.146	0.114	0.029	0.497	0.001	0.003	0.004	0.038
[5]	0.655	0.114	0.031	0.111	0.481	0.896	0.072	0.091	0.158	0.000	0.003	0.033	0.004
[6]	0.326	0.983	0.715	0.544	0.940	0.374	0.114	0.290	0.871	0.131	0.018	0.170	0.212
[7]	0.169	0.500	0.042	0.446	0.196	0.727	0.023	0.047	0.250	0.021	0.001	0.150	0.004
[8]	0.217	0.621	0.068	0.634	0.991	0.966	0.172	0.068	0.736	0.003	0.030	0.009	0.044
[9]	0.702	0.188	0.081	0.342	0.806	0.704	0.021	0.107	0.738	0.013	0.006	0.064	0.209
[10]	0.049	0.383	0.010	0.205	0.321	0.809	0.069	0.317	0.778	0.001	0.002	0.005	0.002
[11]	0.854	0.934	0.063	0.280	0.532	0.715	0.368	0.683	0.565	0.409	0.292	0.945	0.537

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

4.2 Discussion

The results of this study indicate that M-MSEs has implemented several circular economy practices in West Sumatra. Based on the results obtained regarding the entrepreneur's understanding of environmentally friendly production processes, it is known that M-MSEs entrepreneurs in West Sumatra know what an environmentally friendly production process is, with an average score of 4.5 on a scale of 1-7 or 64%. This percentage is quite high considering that there has not been much training attended by owners related to CE.

Environmentally friendly production processes are also known as clean production. Clean production is a voluntary environmental management system because its implementation is not mandatory. Cleaner production is a new way to improve environmental quality by being more proactive. Cleaner production is a term used to describe a conceptual and operational approach to production processes and services by minimizing the impact on the environment and humans from the entire product life cycle [33].

The results of a survey regarding implementing environmentally friendly practices by M-MSEs are shown in Figure 1. These results show that the most environmentally friendly practices implemented are resource-saving production processes (36%) followed by the application of a separate waste collection system (34%).

A good waste management system can be done by improving the existing waste collection and transfer system at that location. The waste collection system is part of the waste management system, which is directly related to the waste producer (in this case, the general public), so it has a significant influence on educating the public in disposing of waste [34]. The application of separating non-organic waste containers and food waste (such as bones or banana leaves), which are organic, in different waste containers will be more optimal [35].

The following result is regarding the obstacles in implementing environmentally friendly M-MSEs. Based on the survey results, it is known that a lack of financial resources is the main obstacle to implementing circular economy practices, followed by a lack of financial support, a lack of support from public institutions, and a lack of consumer interest in the environment. One of the causes of financial factors being an obstacle by entrepreneurs in implementing CE is because the application of CE will cause new cost components in production activities.

Meanwhile, for the enablers for implementing environmentally friendly M-MSEs, the most substantial factor in becoming an enabler for implementing environmentally friendly M-MSEs is business continuity and restoration of the local environment. The least considered enablers are increasing prestige and reducing costs and financial profitability. This is because the entrepreneur owner views this as a great opportunity because going green has become a trending issue in the industry. However, for micro businesses, the enabler to increase prestige and profits is still low because the purpose of this micro business is for business sustainability and the ability to compete with similar product.

5. CONCLUSIONS

The findings of this study indicate that several CE practices have been implemented by M-MSEs in West Sumatra, thus supporting the notion that CE implies a systemic approach to increasing firm value. In particular, resource-efficient production processes have been widely implemented, namely

36%. This achievement is undoubtedly relatively high compared to the rarity of M-MSEs that use residual materials in the production process. The biggest obstacle to implementing CE that employers feel is the lack of financial support in implementing CE. However, companies that have started implementing CE see it as a business opportunity rather than a cost so that CE can be an added value and innovation of the products they produce. The findings of this research become meaningful data for the West Sumatra government in policy making related to strategy to implement CE in M-MSEs, by using correlation data per implementation indicator. Thus, the policy will be more targeted according to the obstacles to be resolved.

The limitation of this study is that the sample scope is too broad causing the research results to be less focused. With the limitations that exist in this study, it is recommended for further researchers to look at the implementation of CE partially in each industrial sector.

REFERENCES

[1] Sofi, M., Sabri, Y., Zhou, Z., Mendis, P. (2019). Transforming municipal solid waste into construction materials. Sustainability, 11(9): 2661. https://doi.org/10.3390/su11092661

[2] Minelgaitė, A., Liobikienė, G. (2019). Waste problem in European Union and its influence on waste management behaviours. Science of the Total Environment, 667: 86-93. https://doi.org/10.1016/j.scitotenv.2019.02.313

[3] Stoeva, K., Alriksson, S. (2017). Influence of recycling programmes on waste separation behaviour. Waste Management, 68: 732-741. https://doi.org/10.1016/j.wasman.2017.06.005

[4] Sihvonen, S., Ritola, T. (2015). Conceptualizing ReX for aggregating end-of-life strategies in product development. Procedia CIRP, 29: 639-644. https://doi.org/10.1016/j.procir.2015.01.026

[5] Su, B., Heshmati, A., Geng, Y., Yu, X. (2013). A review of the circular economy in China: Moving from rhetoric to implementation. Journal of Cleaner Production, 42: 215-227. https://doi.org/10.1016/j.jclepro.2012.11.020

[6] Rosa, P., Sassanelli, C., Urbinati, A., Chiaroni, D., Terzi, S. (2020). Assessing relations between Circular Economy and Industry 4.0: A systematic literature review. International Journal of Production Research, 58(6): 1662-1687. https://doi.org/10.1080/00207543.2019.1680896

[7] Mathews, J.A., Tan, H. (2011). Progress toward a circular economy in China: The drivers (and inhibitors) of eco‐industrial initiative. Journal of Industrial Ecology, 15(3): 435-457. https://doi.org/10.1111/j.1530-9290.2011.00332.x

[8] Kirchherr, J., Reike, D., Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. Resources, Conservation and Recycling, 127: 221-232. https://doi.org/10.1016/j.resconrec.2017.09.005

[9] Zhijun, F., Nailing, Y. (2007). Putting a circular economy into practice in China. Sustainability Science, 2(1): 95-101. https://doi.org/10.1007/s11625-006-0018-1

[10] Bertassini, A.C., Zanon, L.G., Azarias, J.G., Gerolamo, M.C., Ometto, A.R. (2021). Circular Business Ecosystem Innovation: A guide for mapping stakeholders, capturing values, and finding new opportunities. Sustainable Production and Consumption, 27: 436-448. https://doi.org/10.1016/j.spc.2020.12.004

[11] Ghisellini, P., Cialani, C., Ulgiati, S. (2016). A review on circular economy: The expected transition to a balanced interplay of environmental and economic systems. Journal of Cleaner Production, 114: 11-32. https://doi.org/10.1016/j.jclepro.2015.09.007

[12] Prieto Sandoval, V., Torres Guevara, L.E., Ormazabal, M., Jaca, C. (2021). Beyond the circular economy theory: Implementation methodology for industrial SMEs. Journal of Industrial Engineering and Management, 14(3): 425-438. https://doi.org/10.3926/jiem.3413

[13] Hassan, M.K., Saraç, M., Alam, A.W. (2020). Circular economy, sustainable development, and the role of Islamic finance. In Islamic Perspectives on Sustainable Finance Systems. Istanbul University Press.

[14] Saptaningtyas, W.W.E., Kuncoro, D.K.R. (2021). Usulan Model Sistem Jaminan Halal Dengan Pendekatan Ekonomi Sirkular Untuk IKM Pangan [Proposal for a Halal Assurance System Model with Circular Economy Approach for Food M-MSEs]. Proceedings of SNITT POLTEKBA, 5: 277-281.

[15] Roos Lindgreen, E., Salomone, R., Reyes, T. (2020). A critical review of academic approaches, methods and tools to assess circular economy at the micro level. Sustainability, 12(12): 4973. https://doi.org/10.3390/su12124973

[16] Khan, S.A.R., Razzaq, A., Yu, Z., Miller, S. (2021). Retracted: Industry 4.0 and circular economy practices: A new era business strategies for environmental sustainability. Business Strategy and the Environment, 30(8): 4001-4014. https://doi.org/10.1002/bse.2853

[17] Angelina, M., Nursasi, E. (2021). Pengaruh penerapan green accounting dan kinerja lingkungan terhadap kinerja keuangan perusahaan [The influence of green accounting application and environmental performance on corporate financial performance]. Jurnal Manajemen Dirgantara, 14(2): 211-224

[18] Setyawan, D.I. (2018). Peran dinas lingkungan hidup dalam pengawasan limbah pabrik sebagai upaya pencegahan terhadap pencemaran lingkungan di Kabupaten Pati, Jawa Tengah. Universitas Atma Jaya Yogyakarta (UAJY).

[19] Radwan, H.R.I., Jones, E., Minoli, D. (2012). Solid waste management in small hotels: A comparison of green and non-green small hotels in Wales. Journal of Sustainable Tourism, 20(4): 533-550. https://doi.org/10.1080/09669582.2011.621539

[20] Slavík, J., Remr, J., Vejchodská, E. (2018). Relevance of selected measures in transition to a circular economy: The case of the Czech Republic. Detritus, 1(1): 144-154. https://doi.org/10.26403/detritus/2018.12

[21] Kirchherr, J.W., Hekkert, M.P., Bour, R., Huijbrechtse-Truijens, A., Kostense-Smit, E., Muller, J. (2017). Breaking the Barriers to the Circular Economy. Deloitte.

[22] Clube, R.K.M., Tennant, M. (2021). Social inclusion and the circular economy: The case of a fashion textiles manufacturer in Vietnam. Business Strategy and Development, 5(1): 4-16. https://doi.org/10.1002/bsd2.179

[23] Lewandowski, M. (2016). Designing the business models for circular economy-towards the conceptual

framework. Sustainability, 8(1): 43. https://doi.org/10.3390/su8010043

[24] Wijkman, A., Skånberg, K. (2015). The circular economy and benefits for society. Club of Rome.

[25] Hobson, K., Lynch, N. (2016). Diversifying and de-growing the circular economy: Radical social transformation in a resource-scarce world. Futures, 82: 15-25. https://doi.org/10.1016/j.futures.2016.05.012

[26] Korhonen, J., Honkasalo, A., Seppälä, J. (2018). Circular economy: The concept and its limitations. Ecological Economics, 143: 37-46. https://doi.org/10.1016/j.ecolecon.2017.06.041

[27] Yuan, Z.W., Bi, J., Moriguichi, Y. (2006). The circular economy: A new development strategy in China. Journal of Industrial Ecology, 10(1-2): 4-8. https://doi.org/10.1162/108819806775545321

[28] Lieder, M., Rashid, A. (2016). Towards circular economy implementation: A comprehensive review in context of manufacturing industry. Journal of Cleaner Production, 115: 36-51. https://doi.org/10.1016/j.jclepro.2015.12.042

[29] Lacy, P., Rutqvist, J. (2015). Waste to Wealth: The Circular Economy Advantage. Springer.

[30] Friedl, C., Reichl, J. (2016). Realizing energy infrastructure projects-A qualitative empirical analysis of local practices to address social acceptance. Energy Policy, 89: 184-193.

[31] Mura, M., Longo, M., Zanni, S. (2020). Circular economy in Italian SMEs: A multi-method study. Journal of Cleaner Production, 245: 118821. https://doi.org/10.1016/j.jclepro.2019.118821

[32] Rizos, V., Behrens, A., Van der Gaast, W., Hofman, E., Ioannou, A., Kafyeke, T., Flamos, A., Rinaldi, R., Papadelis, S., Hirschnitz-Garbers, M., Topi, C. (2016). Implementation of circular economy business models by small and medium-sized enterprises (SMEs): Barriers and enablers. Sustainability, 8(11): 1212. https://doi.org/10.3390/su8111212

[33] Suroso, E. (2011). Model proses produksi industri tapioka ramah lingkungan berbasis produksi bersih. Jurnal Teknik Kimia, Institut Penelitian Bandung, Bandung.

[34] Larsen, A.W., Merrild, H., Møller, J., Christensen, T.H. (2010). Waste collection systems for recyclables: An environmental and economic assessment for the municipality of Aarhus (Denmark). Waste Management, 30(5): 744-754. https://doi.org/10.1016/j.wasman.2009.10.021

[35] Nawangpalupi, C.B., Pambudi, N.F. (2016). Rancangan tempat dan gerobak sampah untuk perbaikan sistem pengumpulan sampah di taman hutan raya (TAHURA) Ir. H. Djuanda. Jurnal Ilmiah Teknik Industri, 14(2): 153-166. https://doi.org/10.23917/jiti.v14i2.1132