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WASTE MANAGEMENT USING LEAN-GREEN APPROACH: A CASE STUDY IN A FURNITURE COMPANY

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ABSTRACT

Introduction: Wooden furniture is one of Indonesia's superior products, with a low-efficiency level. However, the wooden furniture industry is often associated with intense environmental degradation and high levels of waste. In anticipating waste, a green manufacturing model proposed is Lean-Green manufacturing. This current study aims to explore the implementation of the Lean-Green model in a furniture company's waste processing system and assess the effectiveness of Lean-Green implementation.

Methods: The research methodology was qualitative with the Lean-Green scoring method implemented in the supply chain of Company S. Data were collected through interviews and field observations.

Results: Company S had a low score, meaning that the interaction between the Lean and Green approaches in the waste processing of the supply chain was not optimal. The Lean-Green implementation in the wooden furniture industry was effective in evaluating waste processing in the supply chain. The research findings urge the initiatives to improve the understanding and implementation of the Lean-Green concept.

Conclusion and suggestion: The evaluation of the Lean-Green implementation helps the company's manager improve the supply chain with sustainable measures.

INTRODUCTION

The COVID-19 pandemic has impacted the Indonesian and global economies, causing uncertainty and an economic recession and likely impacting Indonesia's economic growth in the next few years. The highly competitive business environment, with rapid market changes and the importance of customer orientation, has forced organizations to adapt to new work systems. A company needs to look for new opportunities to increase its supply chains by implementing Lean management, which involves increasing quality

and productivity through reduction in costs, time, and waste in all operations (Duarte & Cruz-Machado, 2013). However, a company's growth is influenced by the environmental problems it produces along with the increasing human population. Waste in Indonesia was mostly composed of organic materials in 2021. Given the economic, social, and environmental repercussions, Indonesia faces increasing food waste which becomes a major concern (Bappenas, 2021). Furthermore, it experienced food loss and waste generation in 2000-2019, reaching 23-48 million tons/year. The economic loss that occurs as a result of FLW (Food Loss and Waste) was 213-551 trillion rupiah/year or equivalent to 4% - 5% of Indonesia's GDP per year (OECD, 2020). The highest organic waste is wood or twigs, and one of the wooden wastes comes from the furniture manufacturing industry. To minimize the environmental damage caused by the industry, a new manufacturing process is needed. Green manufacturing is the alternative to the sustainable wooden industry, reducing the environmental risks and negative environmental impacts while increasing ecological efficiency and eliminating environmental waste in organizations (Zhu et al., 2008).

Implementing green manufacturing is not easy for various reasons as it does not practically yield a significant impact on the industrial world, especially in developing countries. There is a growing trend towards producing and purchasing 'green' products and services, even during economic recessions. 'Eco-furniture' or 'green furniture' is furniture products designed to minimize environmental impacts from all manufacturing processes (Papadopoulos et al., 2014). Lean and Green strategies are often seen as compatible initiatives due to their focus on reducing waste, using resources efficiently (Carvalho et al., 2011; Torielli et al., 2010), and meeting customer needs at the lowest possible costs (Duarte et al., 2011). The challenge for companies to become 'green' is how they integrate environmental performance into the business logic (Hockerts & Wüstenhagen, 2010). Lean-Green manufacturing is proposed to anticipate increasing waste (Duarte & Cruz-Machado, 2013). When Lean and Green approaches work together, they are able to maximize the efficiency of production and supply chain. The advantage of Lean and Green is that they are compatible and synergistic systems even though they have different drivers and approaches.

The furniture industry is a vital driver of the global economy (Gabiati et al., 2014). However, it can devastate the environment as it causes significant environmental degradation and high levels of waste in its operational activities (Oliveira et al., 2018). Indonesia is superior for its wooden furniture products, but the industry cannot manage low efficiency in its production. With a mere 50% efficiency level, a wooden furniture factory in Indonesia is plagued by multiple non-value-added activities, such as high installation and changeover times, inappropriate processes, inventory, and defects

(Hartini et al., 2020). Activities that do not provide added value are likely to delay order fulfillment, leading to sanctions and descending the company's reputation (Hartini & Ciptomulyono, 2015). If left unchecked, such conditions could adversely affect business sustainability in the long run (Hartini et al., 2020). The presence of furniture companies increases the waste capacity which types are organic waste, inorganic waste, and B3 waste. Organic waste, such as wood chips or leftover pieces of wood, is environmentally friendly and does not require special treatment for recycling. Conversely, inorganic waste (plastic) and B3 waste (chemicals) pose significant challenges to applying proper disposal. A proposed conceptual framework can help assess the execution of green and lean methods in waste reduction, affecting the entire supply chain of an organization. The framework's criteria are based on assessment frameworks like SP, MBNQA, and EFQM. To implement a Lean-Green waste processing supply chain, initiatives and guidelines should be considered in all areas of an organization following six criteria of the Green and Lean method (see Table 1). Previous studies have shown that various Lean-Green initiatives can achieve environmentally sustainable organizations (Choudhary et al., 2019; Galeazzo et al., 2014; Kovilage, 2021; Malhotra et al., 2022; Pakdil & Leonard, 2015). According to Dror (2008), the Lean-Green scoring method is the most effective in improving a company's green supply chain. Analyzing the urge of Lean-Green method in manufacturing processes, this current study aims to evaluate that method for waste management in the furniture industry.

LITERATURE REVIEW

Lean-Green Integration

The integration of green and lean approaches offers new ways of organization management (Carvalho et al., 2011). Lean and green strategies are often seen as compatible initiatives as they are used for reducing waste, utilizing resources efficiently, and meeting customer needs at the lowest possible cost (Duarte et al., 2011). For effective green and lean supply chains, managers must adopt strategic initiatives such as changing corporate culture, reducing waste, optimizing resources, engaging with employees, being committed to performing good leadership, building trust between managers and employees, creating safer working conditions, persisting relationships between stakeholders, and sharing information (Carvalho et al., 2011; Govindan et al., 2015; Ng et al., 2015). Green and lean supply chains are related to how a product is designed, developed, and supplied to reduce waste, increase productivity, minimize resource costs, and use accurate information to reduce lead times and environmental impacts. While some argue that green and lean approaches are not completely applicable because they do not seem to be integrated to create a new strategy for steady management (Carvalho et al., 2011; Mollenkopf et al., 2010).

Lean-Green Assessment

With the importance of the lean-green approach, Duarte and Cruz Machado (2017) developed an assessment method to evaluate its integration into an organization's supply chain. The lean-green assessment criteria include leadership, people, strategic planning, stakeholders, processes, and results under the organization's supply chain activities. All six criteria work together to provide the analysis of the supply chain performance in terms of waste reduction and exert continuous improvement (Duarte & Cruz Machado, 2017). To achieve successful applications, the lean-green approach should be incorporated into all areas of an organization (Galeazzo et al., 2014; Pakdil & Leonard, 2014).

The lean-green scoring method functions to evaluate businesses that implement green and lean practices, and the method implementation consists of two phases that contribute to the total score composed of the criterion score and the overall score. The observation guide (Fig. 1) is based on the EFQM evaluation, which consists of five levels: "no evidence," "some evidence," "evidence," "clear evidence," and "total evidence" (Duarte & Cruz Machado, 2017). "No evidence" shows no indication of any green or lean implementation. "Some evidence" presents some indications of a green or lean approach, which may be related to either approach. "Evidence" indicates evidence of both green and lean implementation. "Clear evidence" subjects to visible changes as a result from both green and lean implementation. Finally, "total evidence" denotes comprehensive evidence of both green and lean implementation, especially when the two methods are combined.

Objectives Score	0%					25%					50%					75%				100%			
Implementation Green-Lean implementation	No Evidence					Some Evidence					Evidence					Clear Evidence				Total Evidence			
			0	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**	**95**	**100**

Figure 1. Lean-Green objective assessment
Source: Duarte and Cruz-Machado (2017)

An observation sheet needs to be completed to determine an organization's total supply chain score. Criteria for each section of lean-green guidelines are calculated in three steps. In the first step, scores for each criterion with the same reference number are calculated. In the second step, the arithmetic average for each criterion is calculated as the assigned score. In the third step, each assigned score is multiplied by the corresponding criterion score to calculate the total weighted score obtained. The overall lean-green score is the sum of the scores from the calculation results of all lean and green

initiatives and guidelines, ranging from zero to 1,000 points. By using the lean-green assessment method, organizations can evaluate the supply chain.

RESEARCH METHODS

This qualitative study focused on understanding the defined environmentally friendly initiatives implemented by Company S, a wooden furniture manufacturer. The unit of analysis in this case study was the lean-green implementation in the organization's supply chain. This study collected and triangulated data to explore the truth of information through various methods and sources of data acquisition. The data were then analyzed using the lean-green scoring guidelines and interview protocols developed according to company conditions (Duarte & Cruz Machado, 2017). The selected informants included the company owner, production employees in the construction section, and production employees in the finishing section. The informants were parties considered experts in their disciples. The company owner had experience in the furniture business for approximately five years before finally establishing his own furniture company, which has run for 22 years. Production employees and finishing employees have worked in the waste processing of the supply chain since the company started operating.

The analysis of the lean-green scoring guidelines and initiatives aims to evaluate the integration of the lean-green approach into waste management in the company’s supply chain. The interview protocol was developed according to each company's specific conditions. The interview results were compiled into a table for analysis. The data were triangulated and scored after the results of lean-green objective observation were obtained. The observation results resulted from the assigned score of lean-green criteria and the weighted overall score. Table 1 presents lean-green initiatives and guidelines for waste processing in the company’s supply chain. The criteria scale and calculation method are based on the EFQM evaluation.

Table 1
Lean-green initiatives and guidelines indexed by key criteria

Criteria	Green and Lean Initiatives	Green and Lean Guidelines
Leadership	a. Company culture b. Long-term thinking c. Flat organizational structure & validation of leadership from top to bottom d. Legal and regulatory requirements e. ISO 9001 and ISO 14001 management systems f. Vision and mission g. Top management communication and commitment h. Investment opportunities	1. A company must demonstrate environmentally friendly involvement and commitment. The company's leaders and employees should communicate the importance of a green-lean approach and set its goals. 2. A company must guarantee the principles of an environmentally friendly approach (waste reduction and efficiency). 3. A company must establish commitments with stakeholders and communication between them to reduce environmental risks, costs, and time. 4. A company must ensure a hierarchical structure to reduce the loss of information before decision-making. 5. A company must guarantee investment to help implement a lean-green approach. 6. A company must ensure legal requirements and set norms. 7. A company must ensure the implementation of the lean-green management system.
People	a. Employee engagement and empowerment b. Education and training c. Cross-functional teams d. Core skills and competencies e. Ideas and suggestion schemes f. Awards and recognition g. Communication between employees h. Flexible job rotation or job responsibilities	1. A company involves every employee to process waste environmentally, eliminate problems, and make improvements. It must hold kaizen events to choose an environmentally friendly team leader. 2. A company must provide training and education to improve employee skills, as well as implement standard procedures such as cross-functional training, job enlargement and enrichment, and flexible job responsibilities. 3. A company should encourage employees to continuously seek new ways and suggest innovative ideas. 4. Organizations must ensure rewards and recognition for employees. 5. The organization must determine the competencies required for employees.
Strategic Planning	a. Clear green lean strategy b. Shared by all levels of the organization c. Environmental plans and goals d. Strategy with a focus on customers and other stakeholders e. Implementation of strategy and communication	1. A company must ensure a clear lean-green strategy from all levels of the structure. Its supply chain strategy must be aligned with business objectives. 2. A company must establish lean-green plans and goals. 3. Strategies are designed to address the needs of customers and other parties who are considered key stakeholders. Creating a lean-green supply chain strategy must take stakeholders into account. 4. The strategy must be communicated to stakeholders (through meetings or reports). 5. A green supply chain strategy must be carried out systematically.

Criteria	Green and Lean Initiatives	Green and Lean Guidelines
Stake-holders	f. Value for customers g. Strategic alliance h. Long-term relationship i. Close cooperation j. Sharing information k. ISO 9001 and ISO 14001 from suppliers l. Evaluation of suppliers m. Supply control by suppliers n. Customer satisfaction	1. Organizations must focus on creating value for customers, investors, employees, and communities. 2. Organizations must foster proactive and long-term relationships. 3. Organizations should promote commitment and communication between their stakeholders (e.g. suppliers or customers). They need to share information using information technology tools. 4. Organizations must determine strategic alliances that strongly maintain cooperation. 5. The organization must guarantee the selection of suppliers according to green and lean criteria (i.e. must have ISO 9001 and ISO 14001 certification). 6. Organizations should encourage their suppliers to integrate the green method into their business through strategy setting to continuously monitoring their supply chain performance to overcome barriers. 7. Organization must ensure customer demand to ensure their satisfaction.
Processes	a. Process and product focus b. Supply chain procedures c. Sustainable improvement d. Waste reduction e. Eco-Friendly Devices	1. Organizations must focus on processes and products, and they must improve supply chain activities to produce quality products. 2. Organizations must promote continuous improvement by controlling all supply chains. 3. Organizations must identify the best integration between green and lean approaches into supply chain management. Differences between the two method paradigms should be minimized, and inventory strategy and resource capacity or transportation systems in the supply chain are examples that organizations should focus on. 4. Organizations should focus on tools/techniques to increase the success of environmentally friendly supply chain activities. Several tools that can be used along with lean-green method include A3 reports, Kaizen events, or analysis tools. 5. Organizations should promote a better work environment by implementing the 6S methodology. 6. Organizations should use value stream mapping for better processes in terms of information, resources, and waste in current and future conditions. 7. Standardization and work instructions must be defined to document best practices and ensure that organizations have followed them.
Results	a. Monitor all aspects of values b. Steps for lean-green evaluation c. Data analysis d. Cause and effect e. A mix of short-term and long-term results	1. A company must select a performance measurement system and select measures to understand how the company and its supply chain deliver value to customers. 2. A company must analyze data to understand short-term and long-term needs. 3. A company must evaluate the cause and effect of its supply chain behavior.

Source: Duarte and Cruz-Machado (2017)

RESULT AND ANALYSIS

The audit results of lean-green implementation in Company S, as described in Table 2, indicate that the company has a stronger focus on lean initiatives while neglecting to establish, study, and adhere to existing green initiatives. In addition, the company's current lean-green initiatives were carried out without the specified standards. This current study employed several criteria such as leadership, people, strategic planning, stakeholders, processes, and results to identify lean-green implementation. The objective score was obtained based on the guidelines in Figure 1 and discussed with the informants.

Table 2
The analysis of lean-green implementation in Company S

Guidelines	Implementation	Category	Objective Score
Leadership No. 1	Owners were often involved in controlling production activities. Apart from that, the owner was involved in the transaction process and established communication with external waste management parties. The company did not have long-term goals and plans related to the lean-green method but always had short-term plans in every production activity until the product was ready for sale.	Lean	25%
Leadership No. 2	The company managers did not implement the lean-green method; hence, they could not guarantee an environmentally friendly approach.	-	0%
Leadership No. 3	The company ensured that the implemented system was Lean.	Lean	50%
Leadership No. 4	The owner directly communicated problems regarding production and waste processing to production employees. External parties and all employees are directly responsible to the owner.	Lean	50%
Leadership No. 5	The owner and company did not have investment activities in waste-related activities.	-	0%
Leadership No. 6	The company had a trade permit.	Lean	50%
Leadership No. 7	The company did not have any knowledge about the lean-green concept. It only managed waste by selling it to generate profit.	-	0%
People No. 1	Employees involved in the waste processing are production employees only. However, managers were not able to lead the team based on environmental agenda because they only used the lean method.	Lean	25%
People No. 2	Employees in their respective positions were given independent training by the owner and experienced senior employees.	Lean	50%
People No. 3	Employees tend to be spontaneous in expressing their opinions according to the problems they face.	Lean	25%
People No. 4	Employees received bonuses from the company when production activities or waste sales increased.	Lean	50%
People No. 5	Employees were required to master the required competencies, but the company did not have an official job evaluation. The company only set monitoring guidelines.	Lean	25%

Guidelines	Implementation	Category	Objective Score
Strategic Planning No. 1	The most obvious strategy that the company used was the lean method even though they did not implement it professionally. The company had clear directions and goals based on the lean method, but not with a guide. Meanwhile, they still did not know the lean-green guidelines.	Lean	50%
Strategic Planning No. 2	The goal plan focused more on the lean approach.	Lean	50%
Strategic Planning No. 3	The strategy was carried out by the company internally only by guaranteeing secondary output that was distributed to external parties.	Lean	50%
Strategic Planning No. 4	The company communicated strategies only to internal parties. However, it still informed external parties about waste from the production.	Lean	25%
Strategic Planning No. 5	The lean strategy had systematically been implemented, but the green strategy had not been implemented. For green guidelines, the company still needs to study and implement them.	Lean	50%
Stakeholders No. 1	Creating added value for waste processing still did not become the company's focus because the company focused on streamlining and making profits from their waste processing.	Lean	75%
Stakeholders No. 2	Stakeholders in waste processing directly build good personal relationships with the owner.	Lean	75%
Stakeholders No. 3	Internal-external stakeholders often share information with the owner directly or via electronic devices (cellphones) regarding waste processing.	Lean	75%
Stakeholders No. 4	The company agreed to share waste with the external parties wanting to use them for resources. It used a type of non-equity strategic alliance in which two or more companies are partnered under a contract of sharing some resources and capabilities for their advantages.	Lean	75%
Stakeholders No. 5	Suppliers did not implement ISO certification because they did not understand the lean-green approach.	-	0%
Stakeholders No. 6	The company always monitored the quality of the supplies to minimize waste. The selected supplier was guaranteed to be the best and most trusted.	Lean - Green	75%
Stakeholders No. 7	The company could not guarantee the quality of the waste produced because it was not concerned about the residue from their production.	-	0%
Processes No. 1	In the production process, the company always attempted to minimize waste by remanufacturing and reworking waste that still could be used in the next production process. The company also sold the secondary usable waste to stakeholders in need. The recycling process was carried out by external parties. To distribute waste, the company collaborates with external stakeholders.	Lean - Green	75%
Processes No. 2	The company did not focus on their production and waste processing. Therefore, the waste management was done under lean standards, not green ones.	-	0%
Processes No. 3	The secondary waste could pollute the environment and harm health. In each process, no transportation costs were incurred for waste distribution because the waste was transported by external	Lean	50%

Guidelines	Implementation	Category	Objective Score
	parties. The company only provided waste storage space because the rest would be thrown away.		
Processes No. 4	In the waste processing, the company did not use or even know the tools and techniques for the process. In other words, it did not implement the lean-green approach.	-	0%
Processes No. 5	The company did not know or understand any tools that can help implement the lean-green method.	-	0%
Processes No. 6	The employees did not use specific tools in waste processing.	-	0%
Processes No. 7	The waste processing was carried out with standard, unwritten, and informal instructions given by the company owner.	Lean	25%
Results No. 1	The company did not have a performance measurement system, and thus it could not offer added value from the secondary waste.	-	0%
Results No. 2	The company never analyzed waste processing data.	-	0%
Results No. 3	The company conducted several cause-and-effect evaluations of waste processing. However, it did not write the evaluation results systematically and professionally, only spontaneously.	Lean	25%

Source: results extracted by the authors

The company had a strong leadership factor as proven from the years of establishment and its activities. The owner's role contributed to the success of activity execution through direct involvement in production and transactions. Although this company had good lean initiatives, it did not apply a green approach. Support from top managers is important for lean-green method implementation. This study showed differences in lean-green leadership in Company S. In general, the company did not pertain the leadership style according to the standards as it could not show "evidence" in all lean-green leadership guidelines. For example, the management employees ensured the lean method applied in waste processing. The company had a flat organizational structure that facilitates direct communication with the owner regarding waste processing, and it had a legal business status.

Some leadership criteria were proven by "some evidence" at the company. For instance, the owner had control over transactions in the waste processing. However, the company did not have a long-term plan to implement the lean-green method. The company only prepared short-term plans about waste processing with the lean method from each production either per unit or per order. Almost half of the leadership criteria had "no evidence" from the waste processing stages. In this case, the company manager could not guarantee whether the waste management had complied with the lean-green method. One of the reasons is that the company did not invest in waste management from the supply chain. In addition, the company employees lacked knowledge and work experience of implementing the lean-green method.

People are a crucial aspect of the lean-green supply chain. The results showed that the company did not have green management guidelines, giving employees guidance, training, and capability development, only under lean guidelines. The company should provide clear expectations and training for the employees to confidently navigate lean-green practices in their departments.

The company did not have well-standardized people criteria. Production employees were still involved in waste processing. Restrictions from following lean guidelines were applied to the company managers. The employees were not systematically regulated when they wanted to suggest ideas. The company, furthermore, did not have an official evaluation system but only monitoring. On the other hand, the lean guidelines that had “evidence” were found among the employees who underwent training provided directly by the owner and senior employees. Additionally, the company recognized employees’ performance by giving bonuses for overtime work, quicker target completion, and handling of large orders.

Although not always officially documented, strategies and plans were designed to guide the company to achieve its vision and mission. The company should be mindful of the predetermined strategies to avoid changes that could hinder growth and development. Internal communication about waste management strategies was effective, but the company did not provide enough information about its waste management practices to external parties.

The stakeholder relationship in the lean-green criteria was demonstrated with "clear evidence." Despite the minimum spread of information regarding waste management in Company S, it also fostered positive relationships with stakeholders. It formed strategic partnerships, such as the Nonequity Strategic Alliance, which allows the company to leverage resources and manage waste well. The company partnered with mushroom cultivation farmers, used wood collectors, and scrap metal collectors. Besides monitoring the suppliers, the company streamlined the waste management. Hence, the process was still profitable. Having lacking knowledge of ISO 9001 and ISO 14001 certification in its supply chain, the company did not enforce the standardization to the suppliers. Additionally, it did not guarantee the quality of the waste for sale.

As the company did not present evidence on their commitment to lean-green methods, it did not utilize tools or techniques such as the 6s methodology or value stream mapping in waste processing. The organization's commitment was visible in reducing waste by reusing wood waste for furniture production and selling any remaining scrap to external parties. It is evident that the organization properly identified and tracked waste flow although some decisions did not fully align with the lean-green initiatives.

Companies must evaluate the results of their supply chain conducted with lean-green principles. Areas for improvement must be measured using each company's system

or criteria after the implementation of the lean-green method. The company, however, lacked evidence of effective waste management measurement in the short and long term as it was not concerned about that area. Although the company conducted a cause-and-effect analysis regarding the waste supply chain, it was not done professionally.

The lean-green method implementation in Company S was evaluated using the lean-green objective assessment table developed by Duarte and Cruz-Machado (2017). Table 2 shows the interviews and observations of the existing guidelines produce different objective scores for each criterion, far below the standard for assessing the lean-green initiative. The objective score assessment revealed that the lean-green criteria were dominated by a score ranging from 0% to 75%. The result indicated that the company did not completely apply the lean-green method throughout the waste processing.

The company obtained a very low overall score of 242.5 points out of 1,000 points. The leadership and people criteria had a score of 27.5 points and 38.5 points out of 110 points, respectively. The strategic planning criteria had a score of 58.5 out of 130 points, and the stakeholder criteria had a score of 55 points out of 110 points. Furthermore, the process criteria had a score of 54.6 points out of 260 points, and the result criteria had a score of 8.4 points out of a total of 280 points. All of the criteria scores were far below the lean-green assessment standards because the overall score did not reach 25% of the assessment points. Therefore, it can be said that Company S was still "not in compliance" with the lean-green initiatives.

Previous research shows that lean-green practices have good effects on the supply chains of various international automotive companies, achieving scores ranging from 70% to more than 80% in some cases (Duarte and Machado, 2017). However, research in waste supply chains of tofu companies reveals that the interactions between lean-green initiatives were still not high-performed even though they were scored above 30% (Irani, 2022). Some experts believe that lean and green approaches are synergistic (Garza-Reyes et al., 2014; Galleazo et al., 2014; Carvalho et al., 2011; Dües et al., 2013). Therefore, if a company achieves a high score, it is a result of good interactions between the implementation of green and lean initiatives in the company. However, Company S currently under research was far from integrating lean and green initiatives in its waste management. The company should be able to attain sustainable production and waste processing.

The lean-green approach is a valuable tool for supply chains of all company sizes. For furniture manufacturers, natural wood resources as primary raw materials are still beneficial even when they are no longer needed. Lean-green practices are not limited to large companies, small and medium-sized enterprises (SMEs) as well as different sub-parts

of the supply chain can be operated under the principles. By following established lean-green guidelines and initiatives, companies will run their agenda effectively and efficiently.

The current research findings serve as new and additional information for companies who have or have not applied lean-green initiatives under six criteria, i.e., leadership, people, strategic planning, stakeholders, processes, and results. With lean-green assessment, managers can identify areas for improvement and continue to make progress on an ongoing basis.

CONCLUSION

Company S only implemented lean initiatives but was deficient in adherence to the lean guidelines. None of the lean-green criteria showed an objective score of 100%, indicating that Company S did not implement lean-green guidelines fully in waste management. The company's overall criteria score was 242.5 points out of 1,000 points, meaning lean-green guidelines were not put forward professionally or spontaneously. Furthermore, all the existing criteria had an average score of less than 50%, significantly lower than the lean-green assessment standard. Company S should focus on improving evidence of lean-green environmental practices for criteria with an objective score of 0%. The objective scores of the criteria generally ranged from 25 to 75%. With the fluctuating scores, accuracy and professionalism in using the lean-green method are required to assess how the supply chain works to yield improvements. This current study is limited to the waste processing of the supply chain in a furniture manufacturer. However, the conceptual framework is still able to be used in different industries in the future, such as aluminum, plastics, textiles, or paper manufacturers. Future studies can also assess one or more companies and scrutinize the supply chain across the departments and parties, such as their suppliers, stakeholders, even customers, and employees.

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