Environmental Challenges 4 (2021) 100112

Contents lists available at ScienceDirect

Environmental Challenges

journal homepage: www.elsevier.com/locate/envc

Pro-environmental behavior model creating circular economy in steel recycling market, empirical study in Thailand

Wareerath Akkalatham [a], Amirhossein Taghipour [b,*]

[a] Kasetsart University, Thailand, Wareerath
[b] King Mongkut's Institute of Technology Ladkrabang, Thailand

ARTICLE INFO

Keywords:
Circular Economy
Lean Manufacturing Techniques
Social Willingness to Recycle
Perceived Behavioral Control
Pro-Environmental Behavior
Steel Scrap
Thailand

ABSTRACT

The purpose of this study is to examine the variables that influence both the Circular Economy (CE) and pro-environmental behavior in steel recycling manufacturing companies in Thailand. To develop and examine a model using structural equation modeling (SEM), we used a set of CE indicators proposed in previous studies. The variables identified in this study were determined through responses from stakeholders in the steel manufacturing and scrap management industries. A questionnaire-based survey was used to analyze the study target's (foundries, castings, and steel recycling manufacturers) behavior. Respondents contended that they value long-term relationships with suppliers. Quality control has a sizable impact on lean manufacturing techniques. Recycling costs and environmental concerns both have an effect on how behavioral control is perceived. It is critical for society to be educated about the circular economy and its practices. Environmental commitment is the most critical factor in the circular economy's success. The findings indicate that the most significant influence on the Circular Economy is the social willingness to recycle (CE). The study investigates the relationship between social willingness to recycle (SWR) and lean manufacturing techniques (LMT) and the success of circular economy practices. Environmentally responsible behavioral practices both promote and contribute to high levels of productivity. The CE's promotion is critical in light of the current trend toward globalization. We propose that steel manufacturers must continue to innovate in technical or non-technical ways, most notably through the use of efficient equipment such as pre-shredders, shredders, and power plants that accelerate long-term mineral resource savings.

1. Introduction

Steel is a fundamental metal that is used in the manufacture of a wide variety of consumer products, including construction, vehicles, electrical and electronic appliances, tools and equipment, machinery, and manufacturing, all of which are critical for economic growth and the environment (Mahattanalai, 2019). The main disadvantage of the use of complex alloys with steel and concrete in mega projects is that it is exceedingly difficult to remove steel from other components. Also, needed energy to recycle steel from other scraps is primarily important, which may have negative environmental consequences (for example, the amount of energy consumed in carbon (Tingley, Cooper, & Cullen, 2017). Although recycling steel has significant environmental benefits, for example in the United Kingdom, it is uncommon and becoming less common (Jacobi, Haas, Wiedenhofer & Mayer, 2018). This was attributed to a variety of factors, including changes in the demolition process and the adoption of more formal steel certification (Cooper, Skelton, Owens, Densley-Tingley & Allwood, 2016). Continually, a small incentive for common practice may be taken away from steel recycling. Additionally, steel buildings offer a carbon-saving alternative: when a structure is deconstructed, steel components can be remanufactured rather than discarded. Numerous case studies, however, have demonstrated that steel recycling is feasible and can result in significant cost and time savings in addition to carbon savings (Tingley, Cooper, & Cullen, 2017). Costs of production increased until 2018, as domestic scrap metal, steel slabs, and rolled coil imports all increased in price (Mahattanalai, 2019). The average income of traders and distributors decreased by 4% as the cost of domestic steel increased, resulting in lower import prices from buyers. According to the producers, the profit rate was then reduced to 5%. (Mahattanalai, 2019). While some manufacturers manufacture flat steel goods from scrap, they are a small number and, in any case, are now required to bear higher scrap metal purchase costs (because of a supply deficit). Revenue is expected to gradually increase between 2019 and 2021 as the outlook for related and downstream industries improves, but profit margins are expected to remain flat as steel prices continue to decline (Mahattanalai, 2019). Indeed, it is obvious that tools are being used to export waste to the linear model of the past (Ghaffar, Burman, & Braimah, 2020). Additionally, the waste generated during ex-

* Correspondent author.
E-mail addresses: Wareerath.1403@gmail.com, amirtg149@gmail.com (A. Taghipour).

https://doi.org/10.1016/j.envc.2021.100112
Received 12 March 2021; Received in revised form 10 April 2021; Accepted 12 April 2021

ports demonstrates that the product is then used and the waste is left behind, implying that the product will inevitably be wasted at the end of its life cycle. Simply put, this linear economic model is unsustainable. Increased population and consumption resulted in increased waste and depletion of natural resources, which exacerbated the problem of climate change and exacerbated resource scarcity (Ghaffar, Burman, & Braimah, 2020). As a result, the Circular Economy has developed as a viable economic alternative approach to generating value at every stage of production and consumption.

Thailand's economy has grown in size and importance as an export-dependent economy. In 2018, Thailand's Department of Mineral Resources for Contaminants announced that industrial waste management had increased to 22 million tons, with only a small portion recycled (Kamdar, Ali, Bennui, Techato, & Jutidamrongphan, 2019). Over the last decade, this growth has resulted in a 36 percent increase in mineral resource consumption and a 40% increase in imports (Chanthawong, Dhakal, Kuwornu, & Farooq, 2020). Thailand's economic growth has also benefited the middle class, urban development, and domestic consumption.

Thailand has a critical role to play in ensuring sustainable consumption and production, as the country's resource consumption and waste generation continue to grow (Ghosh, 2020). Since the 1990s, recycling has emerged as a significant alternative to open dumping and repository activities in municipal solid waste management (MSW), and has surpassed open dumping and repository activities to become the second most common method of MSW management (Ghosh, 2020). While these dispersed initiatives contribute to waste management efficiency, the CE framework has the potential to add and enhance micro and macro efficiency.

Following several decades of waste management strategies implementation, steps have been taken to incorporate CE as a sustainable concept. For instance, the Ministry of Industry launched a "circular economy program" in 2018 as part of the government's S-curve policy. The Ministry has developed a Roadmap for the Circular Economy in collaboration with private sector firms and the United Nations Industrial Development Organization (Panraluk, & Sreshthaputra, 2020). The S-curve policy will apply circular economic principles to specific industries and will consider all company histories, regulations, and initiatives. Thailand's S-curve (Thailand Approach 4.0) policies are effective at increasing investment and business growth in ten S-curve industries (including automobiles, smart electronics, agriculture and biotechnologies development, food processing, tourism, multimedia, robotics and automation, aviation and logistics, biofuels, and biochemicals). Thailand will make significant progress toward sustainable development in the near future as a result of the CE's implementation (Ghosh, Ed. P.354, 2020).

To analyze the issues confronting steel scrap producers, consumers, suppliers, and the government, we divided them into broad categories that correspond to the areas of concern raised by all stakeholders. The problems were chosen after conducting surveys and conducting interviews. Additionally, we reflect on prior work on the subject, such as Cooper et al. (2016).

1.1. The following issues were identified as a result of previous research

- Costs: This issue encompasses both the cost of reusing steel and the associated costs of adapting to new business practices.
- Program: Any failure in procurement, negotiation, sourcing, price fluctuations, currency exchange rates, demand, or supply can result in significant delays and cost overruns. When a standard procedure is altered, establishing a stable routine is always difficult.
- Quality/certification/traceability: With the introduction of the CE marking, which certifies the steel's properties, the construction industry, particularly manufacturers, has seen a shift in their practices.

Because this mark is typically supplied through the manufacturing process and costs are a major concern for all actors, very few players will consider reusing steel if it is more expensive or takes longer. However, the advantage in one area may compensate for the disadvantage in another. For instance, some delays can be tolerated if costs are reduced, or the program can be accelerated by paying for it.

The assumption that steel recycling is difficult is inconsistent with respondents' actual experience with specific projects. Generally, we believe that reusing steel is difficult in the abstract, whereas specific projects are simple, quick, or inexpensive. It is possible that a shredder factory with a higher density, greater purity, and zero pollution, dubbed prime steel scrap, would have a significant effect on the supply chain.

There is little coordination throughout the supply chain, owing to the significant disconnect between beliefs about issues and the difficulties encountered. The survey's question could be interpreted as follows: what are the challenges associated with steel re-use that are distinct from the challenges associated with steel manufacturing prior to remanufacturing? The relative absence of any barrier that is significantly greater in height than any other barrier is also a cautionary sign (Dunant et al., 2017). While many issues will be resolved in the future, no supply chain operator will support steel recycling from consumers to demolition operators if it results in additional costs or delays (Dunant et al., 2017).

To boost the global economy's circulation, particularly in Thailand, the current study should consider a number of factors. Numerous authors argue that there is a need to raise awareness and advance the CE, as well as to create conditions and improve the CE scenario (Cooper et al, 2016; Dunant et al., 2017; Seemung, 2019). As a result, ASEAN countries recognize the importance of addressing CE barriers, at the very least in their various reports, in order to improve Thailand's circularity opportunities: setting the transition direction (targets and objectives); removing policy barriers; and facilitating cooperation and value-added innovation. The primary goal of this study is to create an optimal environment for the CE to thrive by identifying the criteria used to identify Circular Economics Good Practices, the critical conditions for the CE to thrive, and the roadblocks, and finally, by recognizing the existence of a CE implementation action plan. As a result, the following research questions have been formulated:

- How does the circular economy benefit from (i) social willingness to recycle, (ii) perceived behavioral control, and (iii) lean manufacturing techniques?
- What are the critical conditions that must exist for all stakeholders to practice pro-environmental behavior?
- What are the critical conditions for the circular economy package to benefit Thailand's steel industry?

1.2. Definition of terms

Perceived Behavioral Control: Maichum, Parichatnon, and Peng (2016) described perceived behavioral control (PBC) as another critical component of the TPB model. It is defined as the belief that certain actions are either easy or difficult to accomplish (Ajzen, 2015). Additionally, long-term behavior has been defined as a pattern of behavior that has been demonstrated to be more predictable over time (Gardner, 2015; Nilsen, Roback, Broström, & Ellström, 2012).

Environmental concerns: According to Gkargkavouzi, Paraskevopoulos, and Matsiori (2018), environmental concerns refer to people's awareness of and ability to address environmental issues. Additionally, Maichum, Parichatnon, and Peng (2017) define environmental concerns as a steadfast commitment to environmental safety.

Environmental commitment is defined as "ethical values for environmental protection and green practices for the conservation of industry, community, and the environment" (Singh, Chakraborty, & Roy, 2018).

Pro-environmental behavior is defined as behavior that minimizes environmental damage and prioritizes environmental protection (Keshavarz & Karami 2016). Intentional behavior refers to an individual or group that benefits the environment directly or indirectly (Chakraborty, Singh, & Roy, 2017). Also, Keshavarz and

Karami (2016) defined environmental behavior as an action that improves the quality of the environment, whether intentionally or unintentionally. Environmentally conscious behavior promotes resource conservation, environmental stewardship, and sustainable exploitation of the natural environment (Han 2015; Chakraborty, Singh, & Roy 2017).

2. Literature

2.1. Related research establishing a link between lean manufacturing techniques and the circular economy

Aghayev, Garzai-Reyes, Nadeem, Kumar, Rocha-lona, and Gonzálek-Aleu examined the critical lean manufacturing aspect in Azerbaijan (2020, March). The analysis of data from twenty companies revealed that Azerbaijan's construction industry had not yet reached the level required for top management. More importantly, it was the primary reason workers were not permitted to participate in their own growth.

Saetta and Caldarelli (2020) conducted research in Italy on the impact of manufacturing processes on technological advancement toward economic, social, and environmental sustainability. Ecology and economics are inextricably linked to lean, as "reduce-reuse-recycle" is. Moving toward more environmentally friendly production frequently entails lowering production levels. The effect on production lines must be considered when incorporating the use of inorganic binders in the core production process. The green social dimension is inextricably linked to workplace protection. In either case, the first result demonstrates that transitioning to more environmentally sustainable production requires, if not, a complete redesign of the current production system, at the very least for the portion of production that involves technological advancements.

Gaustad, Krystofik, Bustamante, and Badami (2018) examined the use of lean industrial environmental techniques in the United States to address the circular economy's material criticality as a result of open-source lean manufacturing. Through resource sharing or service economy approaches, waste reduction and quality management gains are shared between lean and circular economies. These bottlenecks have a significant impact on the supply of critical metals used in technologies such as renewable energy. Dematerialization and diversification are two additional circular concepts that have the potential to significantly increase supply security. Numerous of these techniques also have significant secondary benefits; energy consumption, waste reduction, emission reduction, and cost reduction have all demonstrated quantifiable results in the cases examined here. However, any organization's implementation of short-term production methods should be thoroughly evaluated, as there are numerous supply chain interactions in this area.

In India, Yadav, Luthra, Huisingh, Mangla, Narkhede, and Liu (2020) have identified key factors facilitating manufacturing organizations' adoption of lean manufacturing structures in the context of advanced literature economies. They identified improved shop floor management, quality control, and manufacturing strategy as primary drivers of increased adoption of lean manufacturing techniques. Their findings benefit policymakers and researchers working to improve the health of the environment, the economy, and society, particularly in developing countries. Also, their findings influenced the development of incentives and support policies to encourage the adoption of lean manufacturing techniques by small and medium-sized businesses.

Pauliuk (2018) addressed BS 8001:2017 in Germany, but the relationship between the CE and ongoing transitions, as well as its financial, political, and scientific foundations, is ambiguous and at times silent. Pauliuk also stated that standard organizations are fully accountable for selecting CE success indicators, both internally and in collaboration with stakeholders.

Gao and Low (2014) discussed the concept of 'building quality' in Singapore, at a time when an entire production line can be shut down for all operators if a problem or defective product is identified. Construction firms may be aware that this is comparable, provided it is consistent with the overall TQM objective, which has been extensively addressed in the construction sector.

Sweden, Chavez, Romerob, Rossic, Ludliettic, and Johanssona (2019) resulted in a decrease in the environmental impact of manufacturing. Two lean techniques are being developed that will improve both small and large outcomes (cost-consumption and quality flexibility). As expected, implementing lean strategies would result in improved lean performance. They added, however, that implementing all lean methods does not result in a complete boost in performance.

Glass-Hedges (2015) emphasizes the importance of coordination between changes, efficiency improvements, and waste management both inside and outside the plant in the United States. Waste transporters have evolved into commodity traders, as goods from one facility are sold to another as raw materials. He discovered that the lean-recycling connection is expected to persist as recycling becomes a more widely accepted technique for reducing green waste.

Also, in the Netherlands, Van Buren, Demmers, Van der Heijden, and Witlox (2016) discovered how many, if not all, solid waste sources the facility has. The Dutch national government has been a strong supporter of organic farming and has incorporated the circular economy into the coalition government agreement currently in place. As a result, an important program called 'from waste to energy' has been added to the environmental list, as has an economic 'green development' program.

2.2. We thus hypothesized that Lean Manufacturing Techniques have a direct effect on the Circular Economy (H1)

2.3. Related studies in support of the relationship between perceived behavioral control and circular economy

Singh, Chakraborty, and Roy (2018) investigated the availability of a circular economy in the production of small and medium-sized enterprises in India using the theory of the planned behavioral model. Additionally, it has been demonstrated that social and green economic incentives have a significant effect on other predictive components. Major companies' supply chain partners should be informed about sustainable waste management practices such as waste management, lean manufacturing, zero-default and zero-effect management. Additionally, they stated that a company with strong cultural values demonstrates a greater level of trust in the environment and takes green actions to promote sustainable development. Additionally, their findings indicate a positive environmental impact on internal factors, such as owner/manager attitude and behavioral control, as well as external factors, such as social pressure and green economic incentives for environmental commitment.

Thomson (2016) introduced a circular plastics economy model in Australia, providing an interpretation of both individual and organizational behavior. His study demonstrates that while the majority of organizations have good intentions, best practices in plastics recycling have not yet been implemented due to several critical barriers. His study suggests that such steps could be taken to close the compliance gap and achieve a circular economy for plastics.

2.4. We thus hypothesized that Perceived Behavioral Control has a direct effect on Circular Economy (H2a)

2.5. Related studies in support of the relationship between perceived behavioral control and social willingness to recycle

In the United States, Saphores, Ogunseitan, and Shapiro (2012) examined participants' willingness to engage in environmental behavior using Schwartz's behavioral activation and social pressure recycling model. Additionally, their model demonstrates that external variables do not help classify individuals who have experience recycling e-waste but appear to have larger families or are over 60 years old. Their findings suggest that while moral values promotion, public education about

the benefits of e-waste recycling, and e-waste recycling can all help promote e-waste recycling, additional steps may be necessary to address the issue of e-waste. Additionally, in their study, the relationship between household size and recycling behavior is expected to be related to consumption, resulting in significant waste output.

Ittiravivongs (2012, April) conducted a study in Thailand with 381 random samples and discovered that the intention to recycle household goods was significantly influenced by one's attitude toward recycling, subjective standards of community engagement, understanding of recycling profits, perceived ability to recycle, and degree of responsibility. Responsibilities are moderated by economic stimuli and the recycling facility's perceived condition. Increased levels of responsibility appear to mitigate the effect of financial incentives and perceived conditions on the facility's willingness to recycle the household. Additionally, his research discovered that recycling appears to be an act of altruism, with the intention of recycling influenced by a sense of need and obligation. The degree of accountability has had a direct effect on the recycling function, dampening the economic stimulus and the facility's willingness to recycle households. Furthermore, policies should be strictly enforced to promote a positive attitude toward recycling. Thus, it appears as though the purpose of recycling is contingent on their communities' recycling standards. As a result, it is critical for the majority of society's citizens to recycle and act pro-actively. Also, targeted awareness campaigns and education about their recycling responsibilities must be conducted.

Wang, Zhang, Yin, and Zhang (2011) investigated residents' recycling behaviors and preferences for e-waste recovery in China. Additionally, their research assessed residents' capacity for e-waste recycling. To estimate and describe residents' willingness to recycle e-waste, a logistic regression model was developed. The model indicates that four determinants of Beijing's willingness and behavior to recycle e-waste are recycling and operating facilities, housing conditions, recycling practices, and financial advantages. As a result, local residents support initiatives for e-waste recycling, if they are implemented. According to reports, a large number of Beijing residents find it difficult to consider some of the costs associated with e-waste recycling. Additionally, successful re-use and recycling management systems can be built and enforced primarily on the basis of these factors.

2.6. Thus, we assumed that perceived behavioral control had a direct effect on the social willingness to recycle (H2b)

2.7. Related studies in support of the relationship between social willingness to recycle and circular economy

A more extensive dialogue between stakeholders and the general public would be required to clarify the connections between CE, sustainability, social risks, and ethical responsibility. Wang, Dong, and Yin (2018) argued that a person would be less willing to purchase such a car in China, even more so if he or she expressed negative attitudes toward electric vehicles. As a result, the desire to alter established behaviors may have an effect on the purpose and application of circular business models in their analysis. Additionally, they discover that past actions are used to determine whether a habit is appropriate for the Circular Business Model's (CBM) habits, referred to as the habit path. Also, it is discovered in this analysis that habits are calculated using the previous behavior value. The decision to participate or not participate in this CBM is likely to be significantly influenced by such strong habits as an inability to change a strong habit. Finally, the variables included in the prediction models will be analyzed further to determine their relationship to consumers' willingness to participate in CBMs. These various outcomes may shed light on the relationship between the various variables that contribute to this willingness to engage in CBM.

Borrello, Pascucci, Caracciolo, Lombardi, and Cembalo highlighted the correlation between consumer willingness and participation in CBM in Italy (2020). In their study, at $p > .05$, the following variables were not statistically significant: lifestyle, waste management, attitude, and familiarity. The city's size was found to be significant in predicting consumer willingness to participate, with respondents from larger cities demonstrating a greater proclivity.

Wang, Ren, Dong, Zhang, and Wang (2019) discovered that citizens' willingness to participate in online e-waste recovery is an indicator of their intentions. Their findings indicate that individuals who are more concerned about environmental conservation are more likely to participate. Online recycling clearly has a number of advantages over traditional recycling methods, including lower recycling costs and a relatively higher recycling rate. They are committed to increasing public awareness of e-waste recycling via a variety of platforms and to providing continuous propaganda to heighten people's environmental sensitivity and stimulation. The findings indicate that residents with a higher level of education and income are more numerous than those with a lower level of education and income. This could be because people with a higher education are more conscious of environmental conservation and the importance of recycling.

2.8. Thus, we assumed that the Social Willingness to Recycle had a direct effect on Circular Economy (H3a)

2.9. Related studies in support of relationship between social willingness to recycle and pro-environmental behavior

Numerous psychological variables, including attitudes, views, and beliefs, social pressures, social and personal expectations, identity and control, and self-efficacy, have been examined in relation to recycling behaviors (Fielding, van Kasteren, Louis, McKenna, Russell, & Spinks, 2016). Additionally, Busse and Menzel (2014) examined the effect of perceived social and spatial distance on the readiness of adolescents in Germany to engage in environmental behavior. They discovered that adolescents in the sample were more aware of environmental impacts, but also had less activity regulation and exhibited increased impairment in addressing environmental problems. They synthesize theoretical and empirical research on the role of distance in promoting environmentally responsible behavior in an increasingly globalized world. Moreover, these findings indicate that the other-oriented variables correlate with perceived distance more strongly than the egotistic variables do. While this finding is unsurprising, educational initiatives can have an effect on themselves even when the learner is not experiencing any difficulties. Indeed, regional patterns of behavior have far-reaching global implications. The findings, however, suggest that perceived impotence is not the only factor that contributes to pro-environmental behavior in the social-space gap scenario.

Chan and Bishop (2013) discovered in Australia that moral values and behavior are free of prejudice as a result of the two strong correlations. This was determined by determining whether the correlation between the two constructs was significantly less than one and discovered that it was 0.51. As a result, they concluded that, while they were connected, their structures were distinct. It runs counter to the notion that distinct structures should not be associated with prejudice or divergence of opinion. Additionally, Chan and Bishop discovered that a recycling attitude and moral values would be more consistent with Chen and Tung (2014).

Thomas and Sharp (2013) discovered that pro-environmental identities, such as values and attitudes, are associated with a variety of behaviors in the United Kingdom. Those who self-identify as "recyclers" adhere to a broader social standard. Individuals in this category will also have a bad habit of not recycling, and if this habit is particularly strong, it will be difficult to change for any reason. In a broader sense, identity is influenced by a variety of factors, including violence, antisocial behavior, overcrowding, poor health, and debt.

Bissing-Olson and Iyer (2016) examined social factors such as pride, rather than shame, as pro-environmental predictors in Australia. The re-

Table 1
Conceptual model background.

Authors	Variables Used	Title
Pelton, L. E., Strutton, D., Barnes Jr, J. H., & True, S. L. (1993)	Consumers' Willingness to Recycle	The relationship among referents, opportunity, rewards, and punishments in consumer attitudes toward recycling: a structural equations approach. Journal of Micromarketing, 13(1), 60–74.
Vanichchinchai, A. (2019).	Lean Manufacturing Techniques	The effect of lean manufacturing on a supply chain relationship and performance. Sustainability, 11(20), 5751.
Phan, A. C., Nguyen, H. T., Nguyen, H. A., & Matsui, Y. (2019)	Lean Manufacturing Techniques	Effect of total quality management practices and JIT production practices on flexibility performance: Empirical evidence from international manufacturing plants. Sustainability, 11(11), 3093.
Maichum, K., Parichatnon, S., & Peng, K. C. (2017)	Perceived Behavioral Control	The influence of environmental concern and environmental attitude on purchase intention towards green products: a case study of young consumers in Thailand. Int J Bus Mark Manag, 2, 1–8.
Thi Thu Nguyen, H., Hung, R. J., Lee, C. H., & Thi Thu Nguyen, H. (2019)	Perceived Behavioral Control	Determinants of residents' E-waste recycling behavioral intention: A case study from Vietnam. Sustainability, 11(1), 164.
Singh, M. P., Chakraborty, A., & Roy, M. (2018)	Circular Economy	Developing an extended theory of planned behavior model to explore circular economy readiness in manufacturing MSMEs, India. Resources, Conservation and Recycling, 135, 313-322.
Fang, W. T., Ng, E., & Zhan, Y. S. (2018)	Pro-Environmental Behavior	Determinants of pro-environmental behavior among young and older farmers in Taiwan. Sustainability, 10(7), 2186.
Hong, Z., & Park, I. K. (2018)	Pro-Environmental Behavior	The effects of regional characteristics and policies on individual pro-environmental behavior in China. Sustainability, 10(10), 3586.
Saeed, B. B., Afsar, B., Hafeez, S., Khan, I., Tahir, M., & Afridi, M. A. (2019).	Pro-Environmental Behavior	Promoting employee's pro-environmental behavior through green human resource management practices. Corporate Social Responsibility and Environmental Management, 26(2), 424–438.

Table 2
Companies' category.

	Frequency	Percent	Valid Percent	Cumulative Percent
	6	1.5	1.5	1.5
Contractors and subcontractors	18	4.5	4.5	6.0
Highest management level	1	.3	.3	6.3
Import and export trader	24	6.0	6.0	12.3
Iron foundry and foundry,	109	27.3	27.3	39.5
Municipal government agencies, SAO.	19	4.8	4.8	44.3
Producers of factories related to steel, pump mills, lathe, planning, welding, assembly, cutting	78	19.5	19.5	63.7
Recycling plant	145	36.3	36.3	100.0
Total	400	100.0	100.0	

Table 3
Manager's category.

	Frequency	Percent	Valid Percent	Cumulative Percent
Business owner	48	12.0	12.0	12.0
Investor	6	1.5	1.5	13.5
Middle management	128	32.0	32.0	45.5
Operating level	103	25.8	25.8	71.3
Recycling company	1	.3	.3	71.5
Senior management	114	28.5	28.5	100.0
Total	400	100.0	100.0	

sults indicate that over a 2.5-hour period, pro-environmental actions had a positive correlation with pride and a negative correlation with guilt. Environmental pride was associated with subsequent involvement in environmental behavior, but only among those who met more optimistic pro-environmental descriptive criteria.

In the United States, Park and Ha (2012) have expanded on existing research by examining how two distinct customer segments, namely green shoppers (green product buyers) and others, are not. As predicted, green product purchasers have increased cognitive and affective social responsibilities. Green goods customers and non-customers have different perceptions, expectations, and recycled abilities. Their findings indicate that consumers who have previously engaged in or committed to pro-environmental activities are more likely to engage in additional pro-environmental behaviors. At the end of the day, customer recycling may be influenced by cognitive habits, social norms, and personal recycling expectations.

2.10. Thus, we assumed that the Social Willingness to Recycle had a direct effect on Pro-Environmental Behavior (H3b)

2.11. Related studies in support of the relationship between Circular Economy and Pro-Environmental Behavior

Environmental Concerns can motivate people to go the extra mile when it comes to recycling. Additional findings indicate that environmentally sustainable behavior has been influenced by environmental standards and attitudes (Paswan, Guzmán, & Lewin, 2017). Additionally, environmental interventions frequently have an effect on inhibitory and situational environments.

Li, Zhao, Ma, Shao, and Zhang (2019) examined both external and internal influences in China, focusing on demographic and psychological factors, as well as key factors affecting environmental behavior. Carbon conservation and recycling reports, as well as more widely circulated

Table 4
Variable's measurement descriptive statistics.

"	Min Stat	Max Stat	Mean Stat	Std. Dev Stat
Processing management				
1. Technology suppliers need to support management processes.	3	5	4.40	.733
2. Our buyers are interested in implementing an automated purchasing/supply chain process.	2	5	4.19	.886
Supplier partnerships				
3. Establishing long-term relationships with our suppliers is a major achievement.	3	5	4.77	.485
4. We are committed to building long-term relationships with our suppliers.	3	5	4.82	.420
Total quality management				
5. Our quality and delivery efficiency bring back lean manufacturing.	3	5	4.55	.631
6. We have ISO certification for the company system.	1	5	4.49	.955
Inconvenience of recycling				
7. We find it difficult to sort scrap metal for recycling	1	5	3.62	1.222
8. The financial capacity of the Company to sustainably manage scrap is sufficient.	1	5	3.71	1.197
Cost of recycling				
9. We are planning to reduce the cost of production.	2	5	4.73	.661
10. We believe that a circular economy is a good practice.	3	5	4.75	.555
Environmental concern				
11. We are very concerned about the environment.	1	5	4.46	.889
12. We have long-term concerns about the environment.	2	5	4.51	.819
Opportunity				
13. We believe that a circular economy provides the steel industry with business opportunities.	2	5	4.67	.609
14. The circular economy gives our company the opportunity to participate in facilitating the production of recycled steel products.	3	5	4.60	.625
Rewards				
15. Our environmental performance has been acknowledged by the public. (Public relations and awards)	2	5	4.38	.796
16. The government should create a financial incentive for good environmental performance	2	5	4.23	.846
Punishment				
17. Fines must be imposed for non-compliance with the law on recycling.	2	5	4.13	.865
18. The government must provide funds which comply with the recycling regulations.	2	5	4.48	.762
Green economic incentives				
19. Industrial steel buyers are prepared to pay a premium price for clean products.	1	5	4.14	1.006
20. Governments should provide subsidies and tax incentives for the implementation of the Circular Economy.	2	5	4.63	.690
Environmental Commitment				
21. Our organization takes into account the potential environmental impact of products and production processes.	4	5	4.66	.474
22. Our organization reduces the use of virgin resources by stressing the remanufacturing and recycling of resources.	3	5	4.60	.626
Social awareness				
23. Our organization holds workshops and meetings with experts to educate the community.	1	5	4.12	.973
24. Recycling scrap metal is useful in creating a better environment.	3	5	4.62	.567
Environmental policy				
25. Our company has a policy to deal with environmental impacts.	2	5	4.58	.651
26. Thailand's law requires companies responsible for the recycling of scrap metal	2	5	4.23	.881

(*continued on next page*)

Table 4 (*continued*)

	Min Stat	Max Stat	Mean Stat	Std. Dev Stat
Environmental knowledge				
27. We have the knowledge of the appropriate materials for recycling.	3	5	4.34	.705
28. We provide environmental training to the members of the organization so that employees and managers can develop the skills and knowledge needed for a circular economy.	1	5	4.24	.884
Environmental attitude				
29. We are ready to learn about circular economy concepts in our company.	3	5	4.65	.587
30. We do our best to learn the concepts of circular economy.	3	5	4.59	.546

economic actions, indicate a rapid increase in developed and developing countries alike. The researchers assert that studying the factors that influence pro-environmental behavior may be critical for future growth in strategy generation and policy formulation. The authors conclude that a high level of attachment and a higher quality of life are possible, demonstrating the beneficial effect of pro-Environmental behavior on individual lives.

Testa, Iovino, and Iraldo (2020) examined the circular economy and consumer behavior in Italy by examining the role of knowledge seeking in the purchase of circular packaging. Customers seek consistency between their personal attitudes, other environmental practices, and the circular characteristics of packaging through knowledge. They conclude that businesses must provide transparent and unmistakable information to substantiate circular purchasing decisions. ICT solutions can contribute significantly to the spread of technical knowledge about the efficiency of circular packaging.

In China, Liu, Li, Zuo, Zhang, and Wang conducted random interviews with 600 respondents from six urban districts (2009). Their findings indicate that residents have limited knowledge and comprehension of the CE program. They argue that behavioral education should be targeted at younger age groups. Despite the fact that 75.4 percent of people purchase green products, the findings indicate that a greater proportion of respondents prioritize energy-efficient environmental elements and reap certain economic benefits, such as decreased electricity consumption. The majority of respondents view environmental issues through the lens of their own health and safety, rather than considering regional and global ecosystems. These are habits of economic consumption, not preservative-conscious consumption.

Muranko, Andrews, Newton, Chaer, and Proudman (2018) demonstrated in the United Kingdom that businesses can adopt a circular approach to production by implementing a variety of alternative business models. These models require consumer acceptance. However, a number of behavioral barriers are impeding the development and adoption of a Circular Economy at the moment. The Pro-Circular Model of Change is a novel theoretical framework that combines the Theory of Planned Behavior, Pro-Circular Values, and Persuasive Communication in order to identify and influence behaviors that support the Circular Economy's evolution. For the purposes of the model, the behavior that results from resource efficiency prioritization was defined as Pro-Circular. Numerous experts agree that transitioning to a Circular Economy will require a shift in how goods are produced and consumed.

2.12. Thus, we assumed that the circular economy had a direct effect on Pro-Environmental Behavior (H4)

3. Methodology

The sample used in this study was 400 managers, consisting of top and middle managers, selected from steel companies in Thailand. This sample target is selected as the pro-environmental performance is considered by the company's top managers according to the systematic sampling method. Six of the top managers of each company were selected from the sample group. Top managers include positions as business owner, investor, middle management, operational level, recycling company and senior management selected on the basis of systematic steel companies such as contractors, subcontractors, high management level, import and export traders, and foundry and municipal government agencies. For the data analysis of this study, the SPSS 24.0 program was used for demographic and correlation analysis, while the AMOS 24.0 program was used for confirmatory factor analysis (CFA) and structural equation modeling (SEM).

Table 5
Goodness of fit test for confirmatory factor analysis of the model of this study.

Goodness of fit statistics	Levels	Statistics
Chi-square		179.911
Probability level (p)	>0.05	.000
X2/df	<5.00	3.156
RMSEA	<0.08	.074
RMR	<0.05	.030
GFI	≥0.9	.946
Comparative Fit Index (CFI)	≥0.9	.965

4. Results

As shown in Table 6, the total effect of social willingness to recycle (1.305) on pro-environmental behavior is statistically the highest in comparison with perceived behavioral control and lean manufacturing techniques. Later, lean manufacturing techniques have a clear overall impact (.640) on pro-environmental behavior. In addition, the company's willingness to recycle has the highest overall impact (1.296) on the circular economy relative to the perceived behavioral control and lean manufacturing techniques. Subsequently, lean production methods have a clear overall impact (.456) on the circular economy.

- Lean Manufacturing Techniques (LMT)
- erceived Behavioral Control (PBC)
- Social Willingness to Recycle (SWR)
- Circular Economy (CE)
- Pro-environmental Behavior (PEB)

5. Conclusion

Respondents argued that they are committed to building long-term relationships with their suppliers (mean = 4.82), indicating the importance of a strong and long-standing relationship between the steel industry stakeholders. Respondents stated that a circular economy is a worthwhile practice, with (mean = 4.75) indicating the importance of reducing production costs. Respondents confirmed that a circular economy provides a business opportunity for the steel industry, indicating

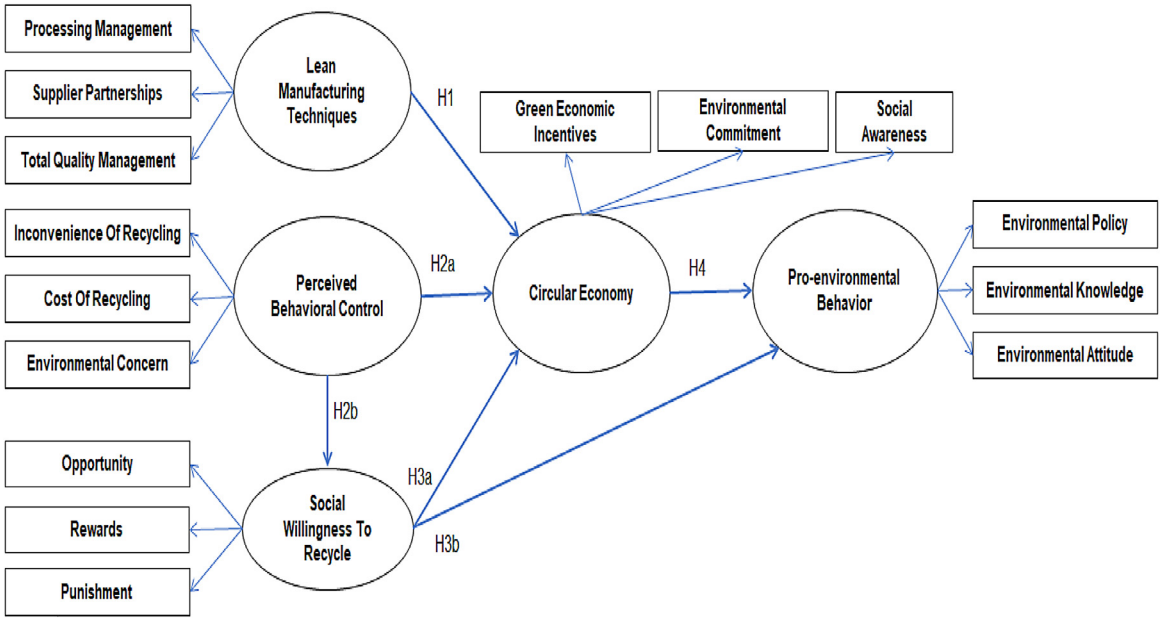

Fig. 1. Research conceptual model.

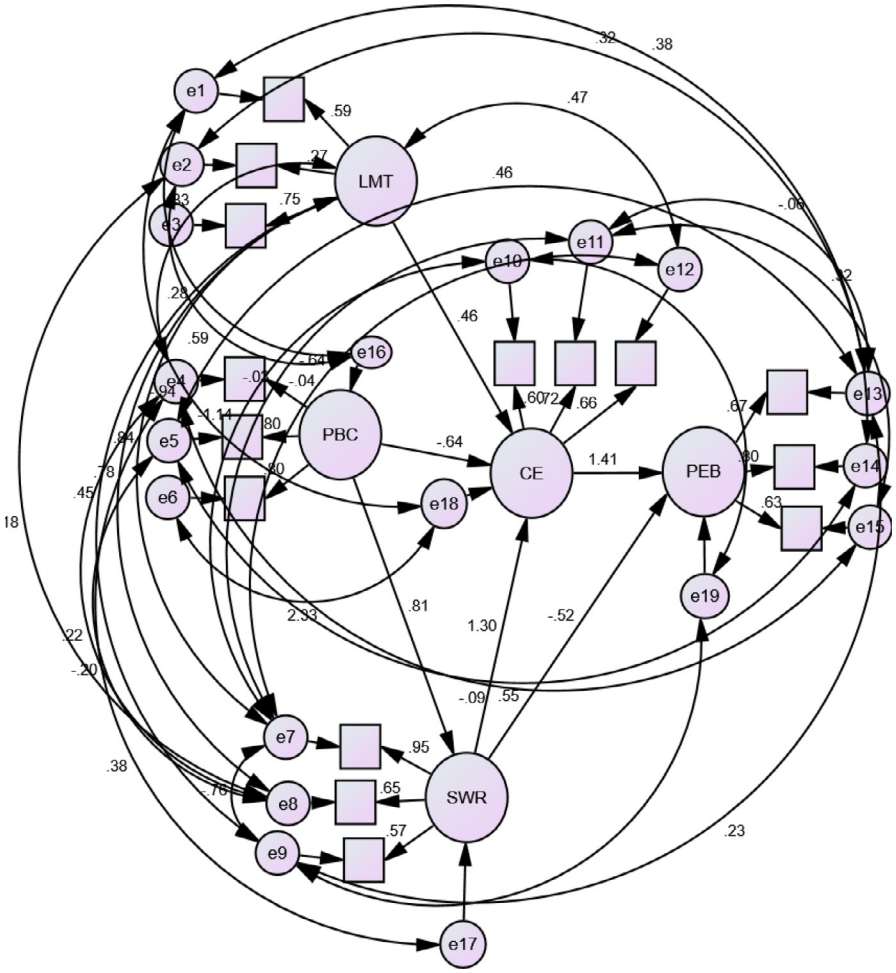

Fig. 2. Standardized modified model results.

Table 6
Standardized modified structural equation modeling total effects.

Variables	Circular Economy			Pro-environmental Behavior		
	Direct	Indirect	Total	Direct	Indirect	Total
Lean Manufacturing Techniques (LMT)	.456	-	.456	-	.640	.640
Perceived Behavioral Control (PBC)	-.639	1.051	.413	-	.161	.161
Social Willingness to Recycle (SWR)	1.296	-	1.296	-.516	1.821	1.305

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

Table 7
Correlations between the variables.

Correlations						
		LMT	PBC	SWR	CE	PEB
LMT	Pearson Correlation	1	.505	.682	.475	.465
	Sig. (2-tailed)		.000	.000	.000	.000
PBC	Pearson Correlation	.505	1	.721	.624	.619
	Sig. (2-tailed)	.000		.000	.000	.000
SWR	Pearson Correlation	.682	.721	1	.726	.662
	Sig. (2-tailed)	.000	.000		.000	.000
CE	Pearson Correlation	.475	.624	.726	1	.709
	Sig. (2-tailed)	.000	.000	.000		.000
PEB	Pearson Correlation	.465	.619	.662	.709	1
	Sig. (2-tailed)	.000	.000	.000	.000	

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

Table 8
Hypotheses testing.

Hypotheses	R	Association	Strength	Results
Lean Manufacturing Techniques has a direct effect on Circular Economy (H1).	.475**	Moderate Correlation	Positive	Supported
Perceived Behavioral Control has a direct effect on Circular Economy (H2a).	.624**	Strong correlation	Positive	Supported
Perceived behavioral control had a direct effect on the social willingness to recycle (H2b).	.721**	Strong correlation	Positive	Supported
Social Willingness to Recycle had a direct effect on Circular Economy (H3a).	.726**	Strong correlation	Positive	Supported
Social Willingness to Recycle had a direct effect on Pro-Environmental Behavior (H3b).	.662**	Strong correlation	Positive	Supported
Circular economy had a direct effect on Pro-Environmental Behavior (H4).	.709**	Strong correlation	Positive	Supported

(mean = 4.67) the importance of a circular economy and the willingness of stakeholders to implement a circular economy. In the context of the role of the government, the respondents argued that governments should provide grants and tax incentives for the implementation of the Circular Economy (mean = 4.63). In addition, the respondents argued that they are reducing the use of virgin resources by stressing the re-use and recycling of resources (mean=4.60). They also said that their organization holds workshops and events with community education experts (mean = 4.12). As a result, environmental concerns (mean = 4.58) together with an increase in quality and efficiency of delivery bring back lean production.

In the case of the steel industry, we have found that overall quality management has a significant impact on lean production techniques (r = .75, Fig. 2.). Processing management is also likely to have an appropriate significance for lean manufacturing techniques (r = .59). Cost of recycling and environmental concerns have the same effects on perceived behavioral control (r = .80, Fig. 2.). The creation of opportunities for stakeholders such as government, private and international organizations is considered to have a very significant impact on the social willingness to recycle (r = .95, Fig. 2.). In addition, the offering of rewards is also taken into account as a further stimulus to the social willingness to recycle (r = .65, Fig. 2.), while punishment strategies do not have a very positive impact on the social willingness to recycle. Environmental commitment is being fulfilled as the most important factor in the circular economy to be considered successful and sustainable by all stakeholders (r = .72, Fig. 2.). It is also very important that society is made aware of the circular economy and its practices (r = .66, Fig. 2). Environmental knowledge, including the life cycle of materials, contamination of scraps such as U-POP, recycling of clean metals, has the greatest impact on environmental behavior (r = .80, Fig. 2.). Similarly, environmental policies and regulations established by international organizations such as the United Nations (UN) or government regulators are considered to play an important role in the environmental behavior of the metal recycling sector (r = .67, Fig. 2). The findings also show that the social willingness to recycle (SWR), having been calculated using SEM and Pearson correlation measurement tools, has the most statistically significant effect on the Circular Economy (r = 1.296, Table 6; r = .726 **, Table 8) supported by Zink and Geyer (2017).

6. Discussion

Gaustad, Krystofik, Bustamante, and Badami (2018) argue that the circular economy (along with other lean manufacturing principles) can be applied to critical and strategic material disruptions. While we found that total quality management has a significant impact on lean manufacturing in the steel recycling industry (H1, Table 8). We have discovered through the use of new technologies such as shredders that proper processing management is critical in steel recycling. While lean manufacturing enables waste to be eliminated during the manufacturing process, conventional buildings are designed on-site using non-standard materials and components, effectively prohibiting lean manufacturing (Minunno, O'Grady, Morrison, Gruner, & Colling, 2018).

Kamble, Belhadi, Gunasekaran, Ganapathy, and Verma (2021) discovered that industry 4.0 technology is frequently used in conjunction with lean manufacturing concepts to reduce manufacturing waste and achieve sustainable results. Similarly, we argue that integrating power plants into recycling facilities has the potential to have a significant impact on the steel industry. Unlike Singh, Chakraborty, and Roy (2018), who discovered a negligible effect of perceived behavioral control on

the Circular Economy, we discovered a significant indirect effect of perceived behavioral control on the Circular Economy (H2a, Table 8).

Wang, Ren, Dong, Zhang, and Wang, 2019 demonstrated that perceived behavioral influence, subjective norms, behaviors, economic incentive, income level, and educational level all influence the willingness to recycle online homes positively. Also, we discovered a strong correlation between social willingness to recycle and perceived behavioral influence (H2b, Table 8).

Boyer, Hunka, Linder, Whalen, and Habibi (2021) discovered that after a 50% redirection, the CE score has less evidence of increasing the consumer's willingness to pay. Han, Yu, Kim, and Kim (2018) discovered that waste reduction and recycling are influenced by social and moral normative factors, as well as environmental sacrificial factors. We have discovered that when recycling opportunities are created in the steel sector, recyclers are more receptive to recycling (H3a, Table 8).

Oliphant, Jaynes, and Moule (2020) discovered that respondents were pessimistic about the ability of other students and society to recycle or practice other environmentally friendly behaviors. Additionally, we discovered that social willingness to recycle has a greater indirect effect on environmental behavior than it has on environmental behavior directly (H3b, Table 8).

Muranko, Andrews, Newton, Chaer, and Proudman (2018); Parajuly, Fitzpatrick, Muldoon, and Kuehr (2020) concluded that by applying planned behavior theory, they altered and maintained Pro-Circular Behavior (TPB). Similarly, we discovered that environmental stewardship and policy have a sizable impact on pro-circular behavior (H4, Table 8).

6.1. Managerial implications

The study explores the impact of SWR and LMT on the success of circular economic practices. Sustainable environmental behavioral practices promote and contribute to high productivity outcomes in developing circular economies. The promotion of the CE is important for managers in the light of the recent trend towards globalization. Steel manufacturing organizations need to survive creative technological or non-technological activities, particularly through the use of efficient equipment such as pre-shredders, shredders and power plants, which accelerate long-term savings in mineral resources. As a result, the findings of this study provide useful insights into the decision-making process and advise management to take reasonable decisions, such as investing in new cleaner technologies.

6.2. Recommendation

This paper recommends that metal and steel companies give priority to their internal capacity to achieve superior efficiency by increasing awareness of circular economy practices, social awareness and promoting ISO standards for circular economy. In particular, we believe that companies should improve employees' environmental knowledge more effectively. The future development and definition of the CE principles should focus on providing more detailed guidance for the quantitative assessment of the results of the CE strategy. Future studies could assess circular economic practices and environmental behavior in other sectors, such as plastics and Metropolitan solid waste. Future studies may also be investigated in different zones and countries.

Declaration of Competing Interest

The authors declared that they have no established conflicting financial interests or personal relationships that may seem to have affected the work reported in this paper.

Funding information

The research does not receive any funding.

References

Aghayev, H., Garza-Reyes, J.A., Nadeem, S.P., Kumar, A., Kumar, V., Rocha-Lona, L., González-Aleu, F., 2020. Lean readiness level of the Azerbaijan construction industry. In: Proceedings of the international conference on industrial engineering and operations management, Dubai, UAE, March, pp. 10–12.

Ajzen, I., 2015. Consumer attitudes and behavior: the theory of planned behavior applied to food consumption decisions. Ital. Rev.f Agricult. Econ. 70, 121–138.

Bissing-Olson, M.J., Fielding, K.S., Iyer, A., 2016. Experiences of pride, not guilt, predict pro-environmental behavior when pro-environmental descriptive norms are more positive. J. Environ. Psychol. 45, 145–153.

Borrello, M., Pascucci, S., Caracciolo, F., Lombardi, A., Cembalo, L., 2020. Consumers are willing to participate in circular business models: a practice theory perspective to food provisioning. J. Cleaner Prod., 121013.

Boyer, R.H., Hunka, A.D., Linder, M., Whalen, K.A., Habibi, S., 2021. Product labels for the circular economy: Are customers willing to pay for circular? Sustain. Prod. Consum. 27, 61–71.

Busse, M., Menzel, S., 2014. The role of perceived socio-spatial distance in adolescents' willingness to engage in pro-environmental behavior. J. Environ. Psychol. 40, 412–420.

Chakraborty, A., Singh, M.P., Roy, M., 2017. A study of goal frames shaping pro-environmental behaviour in university students. Int. J. Sustain. High. Edu..

Chan, L., Bishop, B., 2013. A moral basis for recycling: extending the theory of planned behaviour. J. Environ. Psychol. 36, 96–102.

Chanthawong, A., Dhakal, S., Kuwornu, J.K., Farooq, M.K., 2020. Impact of subsidy and taxation related to biofuels policies on the economy of Thailand: a dynamic CGE modelling approach. Waste Biomass Valorization 11, 909–929.

Chen, M.F., Tung, P.J., 2014. Developing an extended theory of planned behavior model to predict consumers' intention to visit green hotels. Int. J. Hospital. Manage. 36, 221–230.

Cooper, S., Skelton, A.C., Owen, A., Densley-Tingley, D., Allwood, J.M., 2016. A multi--method approach for analysing the potential employment impacts of material efficiency. Resour. Conserv. Recycl. 109, 54–66.

Dunant, C.F., Drewniok, M.P., Sansom, M., Corbey, S., Allwood, J.M., Cullen, J.M, 2017. Real and perceived barriers to steel reuse across the UK construction value chain. Resour. Conserv. Recycl. 126, 118–131.

Fang, W.T., Ng, E., Zhan, Y.S., 2018. Determinants of pro-environmental behavior among young and older farmers in Taiwan. Sustainability 10, 2186.

Fielding, K.S., van Kasteren, Y., Louis, W., McKenna, B., Russell, S., Spinks, A., 2016. Using individual householder survey responses to predict household environmental outcomes: The cases of recycling and water conservation. Resour. Conserv. Recycl. 106, 90–97.

Gao, S., Low, S.P., 2014. The Toyota+ Way model: an alternative framework for lean construction. Total Qual. Manage. Bus. Excell. 25, 664–682.

Gardner, B., 2015. A review and analysis of the use of 'habit'in understanding, predicting and influencing health-related behaviour. Health Psychol. Rev. 9, 277–295.

Gaustad, G., Krystofik, M., Bustamante, M., Badami, K., 2018. Circular economy strategies for mitigating critical material supply issues. Resour. Conserv. Recycl. 135, 24–33.

Ghaffar, S.H., Burman, M., Braimah, N., 2020. Pathways to circular construction: an integrated management of construction and demolition waste for resource recovery. J. Cleaner Prod. 244, 118710.

Ghosh, S.K., 2020. Circular Economy: Global Perspective. Springer Singapore.

Gkargkavouzi, A., Paraskevopoulos, S., Matsiori, S., 2018. Assessing the structure and correlations of connectedness to nature, environmental concerns and environmental behavior in a Greek context. Curr. Psychol. 1–18.

Glass-Hedges, M.N., 2015. Recycling in a Lean Environment.

Han, H., 2015. Travelers' pro-environmental behavior in a green lodging context: Converging value-belief-norm theory and the theory of planned behavior. Tour. Manage. 47, 164–177.

Han, H., Yu, J., Kim, H.C., Kim, W., 2018. Impact of social/personal norms and willingness to sacrifice on young vacationers' pro-environmental intentions for waste reduction and recycling. J. Sustain. Tour. 26, 2117–2133.

Hong, Z., Park, I.K., 2018. The effects of regional characteristics and policies on individual pro-environmental behavior in China. Sustainability 10, 3586.

Ittiravivongs, A., 2012. Household waste recycling behavior in Thailand: the role of responsibility. In: 2012 International Conference on Future Environment and Energy. International Proceedings of Chemical, Biological and Environmental Engineering, 28, pp. 21–26.

Jacobi, N., Haas, W., Wiedenhofer, D., Mayer, A., 2018. Providing an economy-wide monitoring framework for the circular economy in Austria: Status quo and challenges. Resour. Conserv. Recycl. 137, 156–166.

Kamble, S.S., Belhadi, A., Gunasekaran, A., Ganapathy, L., Verma, S., 2021. A large multi–group decision-making technique for prioritizing the big data-driven circular economy practices in the automobile component manufacturing industry. Technol. Forecast. Social Change 165, 120567.

Kamdar, I., Ali, S., Bennui, A., Techato, K., Jutidamrongphan, W., 2019. Municipal solid waste landfill siting using an integrated GIS-AHP approach: a case study from Songkhla, Thailand. Resour. Conserv. Recycl. 149, 220–235.

Keshavarz, M., Karami, E., 2016. Farmers' pro-environmental behavior under drought: application of protection motivation theory. J. Arid. Environ. 127, 128–136.

Li, D., Zhao, L., Ma, S., Shao, S., Zhang, L., 2019. What influences an individual's pro-environmental behavior? A literature reviews. Resour. Conserv. Recycl. 146, 28–34.

Liu, Q., Li, H.M., Zuo, X.L., Zhang, F.F., Wang, L., 2009. A survey and analysis on public awareness and performance for promoting circular economy in China: a case study from Tianjin. J. Cleaner Prod. 17, 265–270.

Mahattanalai, T., 2019. STEEL INDUSTRY. [online] Krungsri.com. Available at: https://www.krungsri.com/bank/getmedia/59ea1063-b869-46ff-9fbf-ce3da6848834/IO_Steel_190827_EN_EX.aspx [Accessed 10 August 2020].
Maichum, K., Parichatnon, S., Peng, K.C., 2016. Application of the extended theory of planned behavior model to investigate purchase intention of green products among Thai consumers. Sustainability 8, 1077.
Maichum, K., Parichatnon, S., Peng, K.C., 2017. The influence of environmental concern and environmental attitude on purchase intention towards green products: a case study of young consumers in Thailand. Int. J. Bus. Mark. Manage. 2, 1–8.
Minunno, R., O'Grady, T., Morrison, G.M., Gruner, R.L., Colling, M., 2018. Strategies for applying the circular economy to prefabricated buildings. Buildings 8, 125.
Muranko, Z., Andrews, D., Newton, E.J., Chaer, I., Proudman, P., 2018. The pro-circular change model (P-CCM): proposing a framework facilitating behavioural change towards a circular economy. Resour. Conserv. Recycl. 135, 132–140.
Oliphant, Z., Jaynes, C.M., Moule Jr, R.K., 2020. Social preferences and environmental behavior: a comparison of self-reported and observed behaviors. Sustainability 12, 6023.
Panraluk, C., Sreshthaputra, A., 2020. Developing guidelines for thermal comfort and energy saving during hot season of multipurpose senior centers in Thailand. Sustainability 12, 170.
Parajuly, K., Fitzpatrick, C., Muldoon, O., Kuehr, R., 2020. Behavioral change for the circular economy: A review with focus on electronic waste management in the EU. Resour., Conserv. Recycl.: X 6, 100035.
Park, J., Ha, S., 2012. Understanding pro-environmental behavior: a comparison of sustainable consumers and apathetic consumers. Int. J. Retail Distrib. Manage. 40, 388–403.
Paswan, A., Guzmán, F., Lewin, J., 2017. Attitudinal determinants of environmentally sustainable behavior. J. Consum. Mark..
Pauliuk, 2018. Critical appraisal of the circular economy standard BS 8001: 2017 and a dashboard of quantitative system indicators for its implementation in organizations. Resources. Conserv. Recycl. 129, 81–92.
Pelton, L.E., Strutton, D., Barnes Jr, J.H., True, S.L, 1993. The relationship among referents, opportunity, rewards, and punishments in consumer attitudes toward recycling: a structural equations approach. J. Micromark. 13, 60–74.
Phan, A.C., Nguyen, H.T., Nguyen, H.A., Matsui, Y., 2019. Effect of total quality management practices and JIT production practices on flexibility performance: Empirical evidence from international manufacturing plants. Sustainability 11, 3093.
Saeed, B.B., Afsar, B., Hafeez, S., Khan, I., Tahir, M., Afridi, M.A., 2019. Promoting employee's proenvironmental behavior through green human resource management practices. Corp. Soc. Respons. Environ. Manage. 26, 424–438.
Saetta, S., Caldarelli, V., 2020. Lean production as a tool for green production: The Green Foundry case study. Procedia Manuf. 42, 498–502.
Saphores, J.D.M., Ogunseitan, O.A., Shapiro, A.A, 2012. Willingness to engage in a pro-environmental behavior: An analysis of e-waste recycling based on a national survey of US households. Resour. Conserv. Recycl. 60, 49–63.
Seemung, J., 2019. Eastern Thailand and its role of innovative industrial centre and Greater Mekong Sub Region Hub: The Reviews of Thai State's Proposal on Development. Grad. Dev. J. 6, 41–68 Ubon Ratchathani Rajabhat University.
Singh, M.P., Chakraborty, A., Roy, M., 2018. Developing an extended theory of planned behavior model to explore circular economy readiness in manufacturing MSMEs. India. Resour., Conserv. Recycl. 135, 313–322.
Sweden Cháveza, C.A.G., Romerob, D., Rossic, M., Lugliettic, R., Johanssona, B, 2019. Circular lean product-service systems design: a literature review, framework proposal and case studies. Procedia CIRP 83, 419–424.
Testa, F., Iovino, R., Iraldo, F., 2020. The circular economy and consumer behaviour: The mediating role of information seeking in buying circular packaging. Bus. Strat. Environ..
Thomas, C., Sharp, V., 2013. Understanding the normalisation of recycling behaviour and its implications for other pro-environmental behaviours: a review of social norms and recycling. Resour. Conserv. Recycl. 79, 11–20.
Thomson, G. (2016). Publication 2: urban fabrics and urban metabolism. Author's declaration, 127.
Van Buren, N., Demmers, M., Van der Heijden, R., Witlox, F., 2016. Towards a circular economy: The role of Dutch logistics industries and governments. Sustainability 8, 647.
Vanichchinchai, A., 2019. The effect of lean manufacturing on a supply chain relationship and performance. Sustainability 11, 5751.
Wang, B., Ren, C., Dong, X., Zhang, B., Wang, Z., 2019. Determinants shaping willingness towards on-line recycling behaviour: An empirical study of household e-waste recycling in China. Resour. Conserv. Recycl. 143, 218–225.
Wang, Z., Zhang, B., Yin, J., Zhang, X., 2011. Willingness and behavior towards e-waste recycling for residents in Beijing city. China. J. Clean. Prod. 19, 977–984.
Yadav, G., Luthra, S., Huisingh, D., Mangla, S.K., Narkhede, B.E., Liu, Y., 2020. Development of a lean manufacturing framework to enhance its adoption within manufacturing companies in developing economies. J. Cleaner Prod. 245, 118726.