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An Investigation into Circular Economy Practices in the Traditional Wooden Furniture Industry

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Abstract

Despite the growing awareness about Circular Economy (CE) in production and supply chain management, there is little evidence linking CE practices to environmental and economic performances, especially within the traditional wood furniture industry in Indonesia. As with other management practices, implementation of CE can be supported by various factors. Among these factors are the so-called environmental-oriented supply chain cooperation (ESCC) practices. The study reported in this paper has three purposes. First, to investigate how the different levels of ESCC practices will affect the CE practices across the traditional wooden furniture industry in Central Java, Indonesia; second, to investigate the relationship between varying ESCC practices (which is grouped based on the implementation of CE practices) on the CE-targeted performances; and third, to examine the role of ESCC practices as a moderating variable in the relationship between CE practices and CE-targeted performances. This study uses primary data which were collected through closed questionnaires to 190 valid samples of wooden furniture SMEs across the cities of Jepara, Kudus, Rembang, Semarang, Blora and Surakarta. The data were processed using confirmatory factor analysis (CFA), K-means clustering analysis, Multivariate Analysis of Variance (MANOVA) and regression analysis. The results indicated that, depending on the levels of ESCC practices, the SMEs could be grouped into leaders, followers and laggard, which also determined the extent to which they practised the CE principles. The study also elaborated on the interactions between ESCC and CE practices, and how these might affect the CE-targeted environmental and economic performances.

Keywords: traditional wooden furniture, circular economy, supply chain cooperation, environmental performance, economic performance

1. Introduction

The Indonesian wooden furniture industry is an export-oriented sector and amongst the biggest producers in Asia along with China, India, Malaysia and Thailand (Priyono, 2009), contributing significantly to the country's manufacturing sector. Currently, almost 140,000 businesses and more than 437,000 employment are being part of the Indonesian furniture industry with an investment value of approximately US $ 333 million. According to the Association of Indonesian Furniture and Handicraft Industries, the value of export of Indonesian furniture in 2017 was approximately US $ 1,627 billion, a 1% increase compared to that of 2016. Despite the significant contribution to the Indonesian manufacturing sector, the competitiveness of the Indonesian wooden furniture industry remains low compared to other countries, especially China and Vietnam.

The Indonesian traditional wooden furniture is characterized by classical details influenced by designs from different historical periods resembling the styles of the 19^{th} century or earlier, and across many regions in Indonesia. Unlike the modern furniture that is usually characterized by simplistic and contemporary design and uses lighter wood tones, brighter fabrics, combined with plastics or metal, traditional furniture is primarily made of dense and heavy wood. Due to its complex design and styles, traditional wooden furniture is often large and heavy, requiring more raw materials than the modern furniture (Yoon et al, 2010).

The requirement for such a large amount of raw materials in recent years has caused numerous issues with the quality and price of raw materials, triggered by the imbalance between supply and demand of rounded timbers, as they are becoming harder and more expensive to acquire. This is also further constrained by the cut down quota of timber logging and clamp down on illegal timber trading. The timber production of the Indonesian national forest was around 22 million m^3 in 2001, but since 2005, the quota has been capped to around 8.1 million m^3.

The burden faced by the traditional wooden furniture industry is exacerbated by their inefficient use of raw materials and production processes, causing the significant amount of waste generated, threatening the environmental sustainability. In many cases, due to their low environmental consciousness, the wooden furniture industry operates a linear, 'take-make-consume-dispose' model of resource consumption, leaving substantial amount of waste as pollutant that jeopardise the ability of natural resources to regenerate. Therefore, given the abovementioned problems, it is crucial for the Indonesian wooden furniture industry to recognize the balance between the environmental and financial aspects, not only in their production process but also in managing their supply chains.

The Circular Economy (CE) is positioned at the opposite end of the linear model, as CE emphasises an economic model that is restorative and regenerative. It represents a life cycle model that focuses on the reusability of materials, and recycling of waste in the product lifecycle beyond the classical view. It also distinguishes between consumable and durable products and suggests that all the energy required to power this economic cycle should be made from renewable resources (Schrödl & Simkin, 2014). At the individual company level, CE practices encompass environmental protection requirements on reduction, reuse, and recycling (3Rs) with an emphasis on achieving the dual environmental and economic performance goals. CE practices typically include internal environmental management (IEM), eco-design (ECO), and investment recovery (IR).

As with other management practices, there exist several important factors that support the implementation of the CE model. Among these factors, the environmental-oriented supply chain cooperation (ESCC) is recognized as one of the determinants in CE. ESCC practices are, for instance, green purchasing (GP) on the upstream side and environmentally-conscious customer cooperation (CC) on the downstream side (Zhu et al, 2010 and Botezat et al, 2018). Zhu et al (2010) and Botezat et al (2018) attempted to clarify the relationship between CE, ESCC, and CE-targeted performance. Their research pointed out the differences in ESCC practices across the manufacturers they surveyed, which subsequently caused the variation in achieving the CE-targeted performance.

Therefore, inspired by Zhu et al (2010) and Botezat et al (2018), this study aims to, first, investigate how the different levels of ESCC practices will affect the CE practices across the traditional wooden furniture industry in Central Java, Indonesia; second, investigate the relationship between varying ESCC practices (which is grouped based on the implementation of CE practices) on CE-targeted performance; and third, investigate the role of ESCC practices as a moderating variable in the relationship between CE practices and CE-targeted performances.

2. Literature Review

2.1. CE practices

One of the important principles of CE is the reduction of environmental impacts from the production system while, at the same time, safeguarding the growth and prosperity of the company. Within an economic system, this is done through minimizing the input of the resources and energy used internally within a company and minimizing the waste and pollution (Bakker et al., 2014; Evans, 2009; Webster, 2017; Kalmykova et al., 2018; Liu et al, 2018). Zhu et al (2010), Botezat et al (2018), and Silva et al (2019), therefore categorised CE practices into three dimensions: internal environmental management (IEM), eco-design (ECO), and corporate asset management and recovery (CAMR) or investment recovery (IR).

The IEM dimension can also be considered as tools and processes which foster a circular approach (Botezat et al, 2018). According to Geng et al., (2016) and Mudgal et al. (2010) the IEM practices can be done through an evaluation of the companies' internal environmental performance metrics, alignment of the policy, mission, vision and values with the corporate environmental responsibility, creation of a common platform of knowledge and information related with environmental responsibility, investment in the ongoing training of employees and dissemination of knowledge to stakeholders related to the environmental awareness.

ECO dimension acts as a tool that incorporates environmental concerns into the design of the product, process or services with the purpose of minimizing life-cycle environmental impacts (Lifset and Graedel 2002). Known by many as "green design", "design for the environment" and "sustainable design", eco-design is also seen as an important method for the development of the CE by the European Environmental Bureau (EEB) and the European Commission (EC) (Mendoza et al, 2017).

Corporate asset management and recovery (CAMR) or, simply, investment recovery (IR) practices seek to achieve benefits by combining obsolete, end-of-life and surplus assets into reverse logistics processes so that these assets can be properly recovered or safely disposed of (Chan et al. 2010). Other IR practices include consolidation of product returns from different locations at the collection stage, recovery of valuable components from used materials at the recycling stage, and sale of refurbished products at the remanufacturing stage (Choi and Hwang, 2015).

According to Bocken and Short (2016), the CE practices may include the maximization the material and energy usage, creation of value from waste, or application of bio-mimicry to shift from non-renewable to renewable resources. Ghisellini et al (2016) considered the practices of CE from the extent to which the three principles (reduction, reuse, recycle) are addressed. Bernon et al (2018) embedded the CE practices into their framework of retail reverse logistics. The practices were later formalised into three layers of principles, attributes and enablers of the CE by Ripanti and Tjahjono (2019).

2.2. ESCC practices

ESCC is an approach that utilizes the customer and supplier cooperation in an environmental management system in order to reduce the consumption of material, water, and energy throughout the supply chain (Zhu et al, 2011). To be successful, the ESCC practices require commitments and contributions from both upstream (e.g. green purchasing - GP) and downstream (e.g. environmentally-conscious customer collaboration - CC) of the supply chain. GP practices related to the practices of a company to consider supplier's environmental products and process performance when making procurement decisions (Yang and Zhang, 2012). The company reflects on the environmental factor as one of the dimensions in the supplier selection, in addition to technology, quality, delivery, cost, services and other strategic dimensions (O'Connor et al., 2011).

GP can be grouped into three major categories, namely product standards, behaviour standards, and collaboration (Green et al., 1998). Product standard strategy is supported by the implementation of an eco-friendly purchasing, i.e. acquiring only environmentally-friendly products (e.g. high content of recycled materials and non-toxic ingredients). While the behaviour standard is related to the willingness of suppliers to disclose any information about their environmental practices, pollution discharges, etc., collaboration is required to enable any cooperation with the suppliers, e.g. to help them reduce environmental impacts through changes in product design and materials use (Dubey et al, 2013).

CC practices entail any cooperation with customers for activities related to environmental performances, such as cooperation with customers to achieve eco-design, cleaner production, green packaging, etc. Through CC practices, a manufacturer perhaps can incorporate the green philosophy in the design of distribution and transportation processes, reduction of carbon emission, wastewater, solid wastes and the consumption of hazardous materials in the downstream supply chains (Zhu & Sarkis, 2004; Green Jr. et al., 2012).

2.3. CE-targeted performances

The CE-targeted performances at the company level, according to Zhu et al. (2011), can be divided into two groups: the environmental and economic performances. The environmental performance is hereby defined as the ability of a company to reduce waste, toxic and hazardous materials (Green et al, 2012b), while the economic performance indicates the ability of the company to reduce costs related with energy consumption, purchased raw materials, fines for environmental accidents, and waste discharge/treatment (Green et al, 2012b). Evidently, the majority of prior research (Bakker et al., 2014; Bocken et al., 2016; Rashid et al., 2014) emphasised on the environmental performance improvements of the CE practices.

Rashid et al. (2013) went on to argue that in order for improve the environmental and economic performances of the companies, they needed to emphasise on sustainable manufacturing, which might be achieved by implementing the circular business models and supply chains. Furthermore, the economic potential of CE is also deemed promising (Liu & Bai, 2014), since a better environmental performance may also contribute to a better economic performance through reduced costs and/or increased revenues (Ambec & Lanoie, 2008).

3. Conceptual model linking ESCC practices, CE practices and CE-targeted performances

Despite the continued discourse in the extant body of literature, the relationship between CE and ESCC practices and CE-targeted performances (consisting of environmental and economic) is arguably less clear; whether ESCC practices (GP and CC) are an essential factor for implementing the CE practices (IEM, ECO, IR), which in turn become a critical factor in improving the company performance (Zhu et al, 2010).

Previous research conducted by Zhu et al (2010) and Botezat et al (2018) demonstrated that there was a great deal of variation in Chinese and Romanian manufacturers they studied with regard to the implementation of ESCC practices. This variation apparently influenced the CE practices in those countries. Based on the degree of variation in ESCC practices, Zhu et al (2010) grouped the sample of Chinese manufacturers into four types, namely leaders, followers, manufacturers, and laggards. Each group exhibited variation in their CE and ESCC practices. Manufacturers type 1 (leaders) have a higher value of mean for GP and CC and also for IEM, ECO, and IR; whereas, manufactures type 4 (laggards) have a much lower value for GP and CC and also for IEM, ECO, and IR. It was suggested that the ESCC practices are positively correlated with the CE practices (Zhu et al, 2010). Similarly, based on the degree of ESCC practices, Romanian manufacturers were clustered by Botezat et al (2018) into two, based on a scoring system. Those that scored high on ESCC practices also exhibited high mean values for CE practices (IEM, ECO, and IR); conversely, those scoring low on ESCC practices, also exhibited low mean values on CE practices (Botezat et al, 2018).

The relationship between CE practices (IEM, ECO) and ESCC practices (GP and CC) may exist due to the pressure in supply chain exerted by suppliers or customers. This pressure can act as a tool to encourage the uptake of IEM and ECO (Gunningham, 2007). The implementation of ESCC practices can trigger IR-related practices, such as reverse logistics (Sheu, 2008), but they need to be accompanied by internal coordination of CE practices. The senior management support, as an essential element of IEM practices, is very much expected, as it boosts innovation and pro-activeness of the ESCC practices. Moreover, as pointed out by Chung and Wee (2008), ECO is a critical factor affecting the success of ESCC practices.

The abovementioned arguments thus lead to the following hypothesis:

Hypothesis 1 CE practices are positively correlated to ESCC practice

The achievement of the CE-targeted performances (economic and environmental) at the company level depends on the ESCC practices conducted by the company, since at this level, the implementation of CE principles requires a robust cooperation between suppliers and customers within the supply chain management (Botezat et al, 2018). According to Darnall et al (2008), this cooperation is instrumental in improving the environmental performance. In line with Darnall et al (2008), the research conducted by Green et al (2012b) showed that the environmental cooperation with suppliers had a direct impact on environmental monitoring of suppliers; whereas environmental cooperation with customers had a direct impact on environmental monitoring of customers. Both environmental monitoring of suppliers and customers have a positive impact on the environmental performance. Moreover, Luthra et al (2015) indicated that implementation of green concept at the company level required a full support from the suppliers and customers.

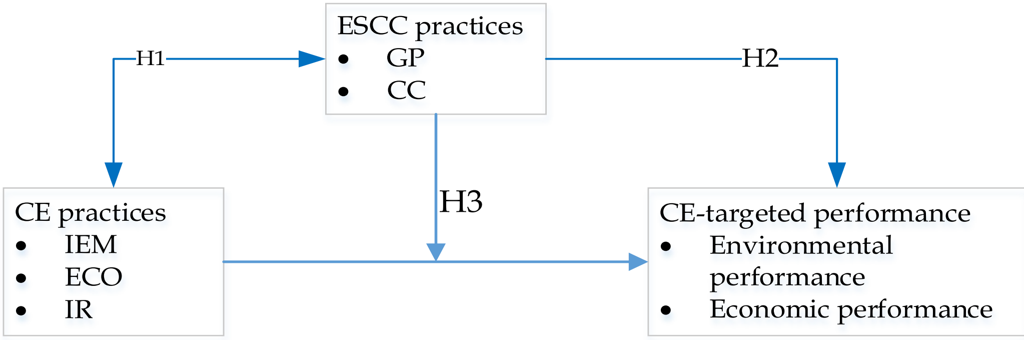
The cooperation between companies and their suppliers creates a positive impact on green purchasing, which in turn will improve the environmental performance (Green et al 1998; Geffen and Rothenberg 2000; Hollos et al. (2012). The cooperation can also produce a better information quality (Irani et al, 2017) and may encourage the companies to develop a detailed environmental policy and planning in their supply chain management (e.g. recycle content of packaging and solvent emissions), providing a basis for reducing the environmental impact of the material flows. Moreover, the cooperation between the companies and their suppliers to lessen product and process environmental burdens, may help reduce unnecessary waste and improve the efficiencies in coordinating activities across the supply chain (Seuring and Muller, 2008). This way, the cooperation between companies and their customers has a positive impact on customer's green cooperation, which in turn will improve the environmental performance (Green et al, 2012a). This cooperation also allows a company to implement environmental improvement projects to reduce pollution in the downstream supply chains (Vachon & Klassen, 2006), enables a manufacturer to comply with various environmental regulations in different markets, thus enhances the operational performance and competitiveness (Yang et al., 2013).

The cooperation between suppliers and customers is also an important factor in attaining the CE-targeted economic performance. Rao and Holt (2005) consider that green purchasing practices can help companies reduce waste produced by the supplier and to minimize waste of hazardous materials. In so doing, green purchasing can promote the companies' economic performance. As an example, the companies can ask their suppliers to minimize plastic packaging and use recyclable or reusable materials, pallets and containers. The positive impact of green purchasing on economic performance was also set forth by Jayarathna et al (2018), while Esty and Winston (2009) took a different slant in revealing the link between customer cooperation on performance measures. Nonetheless, both of them found that customers lowered their environmental footprint and related costs-benefits that justified price premiums, drove increased market share, and strengthened customer loyalty.

In line to the argument that CE-targeted performances depend on the ESCC practices, this study therefore proposes the following hypotheses to test the relationships between CE practices, ESCC practices, and CE-targeted performances.

Hypothesis 2	ESCC practices are positively correlated to CE-targeted performance
Hypothesis 3	ESCC practices are positively moderate the relationship between CE practices and CE-targeted performances

To examine the roles of ESCC on both CE practices and CE-targeted performances, a conceptual framework is proposed in Figure 1.



IEM = internal environmental management; ECO = eco-design; IR = internal recovery; GP = green purchasing; CC = customer cooperation.

Figure 1. The conceptual model showing the relationship between ESCC practices, CE practices, and CE-targeted performances

4. Research method

4.1. Subjects of the research

The study was conducted at the wooden furniture industry in Central Java Province, across the cities of Jepara, Kudus, Rembang, Semarang, Blora and Surakarta. Out of those cities, Jepara is the largest in scale of production with nearly 12,000 workshops, showrooms, and warehouses, and employs nearly 120,000 workers, processes 0.9 million m^3 of wood per year, and accounts for 26% of the district's economy (Larasatie, 2018). Despite the number of people employed, Jepara wooden furniture industry, along with the other cities mentioned above, has produced specialized products targeted for overseas markets (Alexander and Alexander 2000).

This study thus collected the data of CE practices, ESCC practices and CE-targeted performances from several traditional wooden furniture Small and Medium Enterprises, hereafter referred to as 'the SMEs', in the above-mentioned cities. To reduce bias, only the SMEs who met our selection criteria were approached and asked to participate in this study. We looked for the SMEs who owned workshops and manufactured furniture, not merely sellers or distributors. The respondents should have a minimum of one year working experience and are directly involved in CE and ESCC practices. This is to ensure that the SMEs are not only demonstrating awareness of CE and ESCC practices, but also have actually practiced them. Due to these stringent criteria, coupled with the need to ensure a voluntary participation from the subjects, the sample size in a region, may not necessarily proportional to the total population. Nonetheless, we are confident that the 190 valid samples we collected were sufficient for our analysis. In summary, 21 samples (11.05%) were obtained from the questionnaire filled out by SMEs in Jepara, 65 samples (34.21%) from Blora, 33 (17.37%) from Kudus, 15 (7.89%) from Rembang, 43 (22.63%) from Semarang, and 13 samples (6.84%) originated from Surakarta.

The Indonesian Central Bureau of Statistics categorised Indonesian businesses into four groups, i.e. micro, small, medium and large sizes. Micro-size businesses are those having 1 to 4 employees; small-size businesses employ 5 to 19 employees; and medium-size businesses are those employing more than 100 employees (Central Bureau of Statistics, 2014). Various criteria have also been used to classify SMEs, some of which include sales turnover, investment, capital structure, total net assets, employment, etc. Ayyagari et al. (2003) observed that even though the same criteria apply, definitions may still vary across countries. Out of 190 SMEs we surveyed, 125 of them (65.79%) are considered small-size businesses and 65 (34.21%) are medium-size. Moreover, according to the types of furniture manufactured, 109 of the businesses (57.37%) manufactured outdoor furniture and 81 (42.63%) manufactured indoor furniture. Outdoor and indoor furniture workshops differ in the design of products, thus finishing processes, and subsequently the amount of waste generated.

4.1. Research constructs and measurement items

The three constructs employed in this study were adopted from Zhu et al (2008, 2010, 2013). The first construct, consisting of three dimensions and twenty-one items, is used to measure the CE practices. Eight items are used to measure the eco-design (ECO) practices, seven are used to measure the internal environmental management (IEM) practices, and six are used to measure the internal recovery (IR) practices. The second construct is used to measure the ESCC practices, containing two dimensions and nine items. Five items are related to the GP practices and four items are used to measure the CC practices. The final construct is used to measure the CE-targeted performances, which consists of two dimensions and ten items; five items are used to measure the economic performance (ECP) and the remaining five items are used to measure the environmental performance (ENP).

Twenty one measurement items on CE and nine measurement items on ESCC were operationalized in the questionnaire using a five-point Likert scale, ranging from “not considering it” to “implementing successfully” (1 = not considering it; 2 = planning to consider it which means in early phases of discussion and consideration and may not be considered for final implementation; 3 = currently considering it, meaning that the practice has been planned for and on the way to implement but not carried out yet; 4 = initiating implementation; 5 = implementing successfully). Ten items on CE-targeted performances were employed in the questionnaire using a five-point scale, from “not significant at all” to “highly significant” (1 = not significant at all; 2 = some but insignificant; 3 = some and slightly significant; 4 = significant; and 5 = highly significant). The measurement items used in this study can be seen in Table 1.

Table 1. Measurement Items of GP, CC, IEM, ECO, IR, ECP and ENP

Dimension	Measurement items	Item-total correlation	Cronbach's alpha values
Green Purchasing (GP)	• Policy that suppliers must provide legal timber (GP1) • Policy that suppliers must provide wood that has expired (GP2) • Cooperate with suppliers of wood that have expired for differentiating furniture products (GP3) • Cooperate with suppliers of wood that have expired for manufacturing by-products (GP4) • Cooperate with suppliers to supply additional materials that are not harmful to the environment (GP5)	0.148-0.558 (low to high)	0.664

Dimension	Measurement items	Item-total correlation	Cronbach's alpha values
Collaboration with customer (CC)	• Working with consumers to design furniture products that are easy to re-use, remanufacture, and recycle. (CC1) • Communicate to consumers so that they do not object to furniture products that come from wood material that has expired. (CC2) • Cooperate with consumers to establish a special system for collecting used (used) furniture products so that it can be used as alternative furniture products (CC3) • Cooperate with consumers to establish a special system for collecting used (used) furniture products so that they can be made as a by-product (CC4)	0.508-0.694 (high)	0.796
Internal environmental management (IEM)	• Implement reuse, recycle, and remanufacture practices on waste wood management with the owner's commitment (IEM1) • Implement reuse, recycle, and remanufacture practices on waste wood management with the support of workers (IEM2) • The involvement of all workers in the practice of reuse, recycle, and remanufacture the management of wood waste (IEM3) • Willingness to accept suggestions from the workers to improve the implementation of reuse, recycle, and remanufacture in the process of managing wood waste (IEM4) • Providing training to increase environmental awareness of wood waste management (IEM5). • Special training on knowledge and skills in managing wood waste (IEM6) • Discussion of wood waste management activities in evaluating the performance of internal business units (IEM7)	0.329-0.555 (medium to high)	0.777
Eco-design (ECO)	• Use recycle of wood for making a new furniture (ECO1) • Application of policies to produce furniture products whose wood materials / components can be reused (ECO2) • Policy for producing furniture products where the wood component material used can be reused (ECO3) • Policy for producing furniture products where wood component materials used can be remanufactured • Avoid the consumption of hazardous additives in the design of furniture products. • Reduce the consumption of hazardous additives in the design of furniture products • Application of production processes that can minimize wood waste	0.496-0.655 (medium to high)	0.834

Dimension	Measurement items	Item-total correlation	Cronbach's alpha values
	• Application of production processes that can minimize products, components, and material defects		
Internal recovery (IR)	• Policy to sell excess wood inventory / material (IR1) • Policy for selling defective wood products, components or materials (IR2) • Policy for selling the wood waste (IR3) • Policy to collect and recycle wood from furniture products / materials that have expired (used) (IR4) • Policy to establish a recycle system of used furniture products / materials (IR5) • Policy to establish a recycle system from defective furniture products (IR6)	0.118-0.494 (low to medium)	0.601
Economic performance (ECP)	• Increase in percentage of income due to activities from wood waste management activities (ECP1) • Decrease in percentage of cost due to purchase a new wood (ECP2) • Decrease in percentage of costs due to defective furniture component / material (ECP3) • Decrease in percentage of costs due to excess wood inventory (ECP4) • Decrease in percentage of costs due to wood waste disposal (ECP5)	0.440-0.584 (medium to high)	0.749
Environmental performance (ENP)	• Increase the percentage of recycle wood used in production process (ENP1) • Increase the percentage of wood waste being processed with recycle method (ENP2) • Increase the percentage of wood waste being processed with the other methods –reuse, remanufacture (ENP3) • Decrease the percentage of wood waste being processed with incineration method (ENP4) • Decrease the amount of wood waste stored by the enterprises (ENP5)	0.440-0.639 (medium to high)	0.760

4.2. Data processing

This study employs the item-total correlation to determine the validity of the measurement items and the Cronbach's alpha values to determine the reliability of the measurement items. Moreover, to validate the measurement scales for all the theoretical constructs, a confirmatory factor analysis (CFA) was performed using AMOS. GP and CC, describing the two dimensions of ESCC, have the item-total correlation in the range of 0.148 - 0.588 and 0.508 - 0.694 respectively, with the Cronbach's Alpha value of 0.664 for GP and 0.796 for CC. IEM, ECO and IR, the three dimensions of CE practices, have the item-total correlation in the range of 0.329 - 0.555, 0.496 - 0.655, and 0.118 - 0.494 respectively. IEM, ECO and IR have the Cronbach's Alpha of 0.777, 0.834 and 0.601 respectively. ECP and ENP, the two dimensions of the CE-targeted performances construct, have the item-total correlation in the range of 0.440-0.584 and 0.440-0.639 respectively, with Cronbach's Alpha values of 0.749 for ECP and 0.760 for ENP. Cohen (1988) classified the values of the correlation coefficient into three categories: low (0.10 to 0.29), medium (0.30 to 0.49) and high (0.50 to 1.00). GP has a value of item-total correlation that sits in the category of low to high, CC is in the high category, both IEM and ECO are in the category of medium to high, IR is small to medium, ECP and ENP are both medium to high. All of construct have Cronbach's Alpha value higher than 0.6 which is indicated that all of the constructs (GP, CC, IEM, ECO, IR, ECP, and ENP) are reliable (Akter et al, 2011).

CFA specifically relies on several statistical tests to determine the adequacy of model fit to the data, for instance a normed χ2 (normed chi-square), Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), and Goodness-of-Fit Index (GFI). The values of normed χ2 that are close to 1.00 indicated that the model has a good fit and the values of normed χ2 less than 2.00 or 3.00 indicated the model has an adequate fit (Holmes - Smith, 2000). The RMSEA values that are less than or equal to 0.05 indicate that the model has a good fit; the values of between 0.05 and 0.08 indicate an adequate fit, the values of between 0.08 and 0.10 indicate a mediocre fit, and the values larger than 0.10 are not acceptable (Browne and Cudeck, 1993). CFI ranges between 0 and 1. The GFI value of above 0.90 indicates that the model has a good fit (Hair, et al, 2010). The higher the GFI, the better the model. A GFI value that is more than or equal to 0.80 indicates that the model has a marginal fit (Handley and Benton, 2009), the GFI value that is greater than 0.800 and less than or equal to 0.95 indicates that the model has a good fit (Browne and Cudeck, 1993; Bentler, 1990; Hu and Bentler, 1999). Table 2 shows the results of the statistical test from the CFA of ESCC practices, CE practices and CE-targeted performances.

Table 2. The result of statistical test from the CFA of ESCC practices, CE practices, and CE-targeted performances

Construct	Cut-off value	Normed χ2	RMSEA	CFI	GFI
ESCC practices	**Normed χ2** Normed χ2 close to 1.00→ a good fit Normed χ2 less than 2.00 or 3.00→ an adequate fit **RMSEA** RMSEA≤0.05→ a good fit; 0.05<RMSA≤0.08 →an adequate fit; 0.08<RMSA≤0.1→ mediocre fit **CFI** CFI>0.9 → a good fit **GFI** GFI≥ 0.95 → a good fit; 0.8≤GFI<0.95→ a marginal fit.	1.807 (good fit)	0.065 (adequate fit)	0.912 (good fit)	0.883 (marginal fit)
CE practices		2.719 (adequate fit)	0.095 (mediocre fit)	0.952 (good fit)	0.954 (good fit)
CE-targeted performances		1.859 (good fit)	0.067 (adequate fit)	0.956 (good fit)	0.946 (good fit)

5. Results

5.1. ESCC practices across the SMEs

Initially, this study separated the data of ESCC practices into two, three, four and five clusters with the K-means cluster analysis. Then, the Calinski-Harabasz index (CHI), or also known as the variance ratio criterion (VRC), was used to find the optimal number of clusters. Well-defined clusters have a large between-cluster variance and a small within-cluster variance. Moreover, the optimal number of clusters is achieved at the highest value of CHI (Mary et al, 2015). By comparing the variance of GP, CC, and ESCC practices between the clusters and within a cluster for two to five clusters, this study found that the highest CHI value was attained when the data were grouped into three clusters. Therefore, the degree of variation in ESCC practices across the SMEs was finally grouped into three clusters, and the results can be seen in Figure 2.

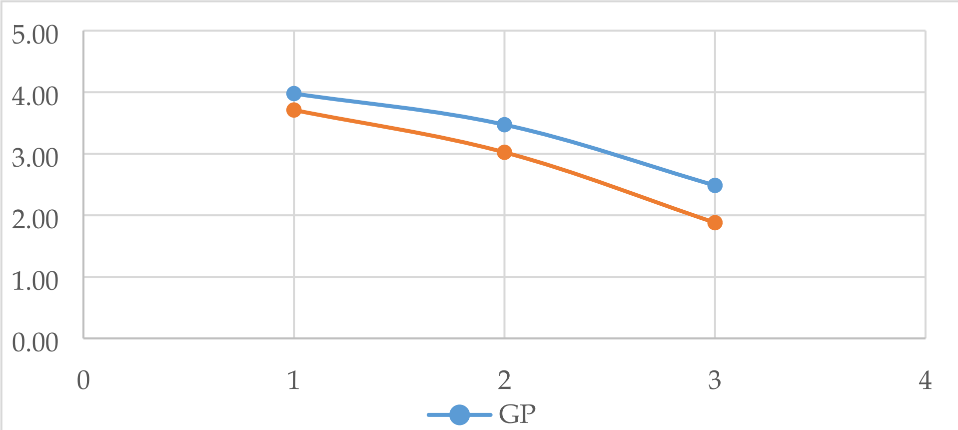


Figure 2. ESCC practices for each type of SME

The phenomenon shown by the SMEs clusters was inherently different from that of Zhu et al (2011). The type 1 SMEs have the mean values of GP and CC being 3.98 and 3.71, respectively. These values are closer to 4, meaning that most of the type 1 SMEs are already at a stage whereby the ESCC practices have been implemented. This study considers this type of SMEs as the ESCC leaders. The type 2 SMEs typically have mean values of GP and CC being 3.47 and 3.02, respectively. As these values are close to 3, the SMEs are at a stage to consider the implementation of ESCC practices, or the practices have been planned for, or on their way to implement ESCC practices. This study labels this type of SMEs as ESCC followers. The ECSS laggards are the type 3 SMEs whose GP and CC practices values are 2.49 and 1.88, respectively, that are closer to 2. These SMEs are in early phases of discussion and consideration and may not have considered the implementation of ESCC practices.

The three clusters indicated that the implementation of ESCC practices has indeed varied across the companies.

5.2. Relationships between CE practices, CE-targeted Performances and ESCC practices

The results of the MANOVA test for CE practices can be seen in Table 3. This study found differences in the implementation of CE practices across the three types of SMEs, with a Pillai's trace value of 0.192 (p value=0.000), a Wilks' lambda value of 0.809 (p-value=0.000), and a Roy's largest root value of 0.227 (p-value=0.000). Table 3 also shows that all the CE practices are significantly different for the three types of SME with the level of significance that is less than 0.05. However, if we compare the value of IEM and ECO for the three types of SMEs, it can be concluded that hypothesis 1 is not fully supported. The first type of SMEs with the highest value of ESCC practices have a lower value of IEM and ECO compared to the third type of SME with the lowest value of ESCC; the third type of SME has the highest value of IEM and ECO. This condition can be explained through an observation to those SMEs. The more SMEs collaborate with their suppliers and customers (for a better implementation of the environmental improvement projects to reduce waste in the upstream and downstream supply chains), the less waste generated from the production process, which, in turn, makes the IEM and ECO practices have not been effectively practised by the companies.

Table 3 Results of MANOVA test for CE Practices

MANOVA for CE practices						
CE practices	Type 1: ESCC Leaders (n = 64)		Type 2: ESCC Followers (n = 105)		Type 3: ESCC Laggards (n = 21)	
	Mean	Std, Dev.	Mean	Std, Dev.	Mean	Std, Dev.
ECO	3.5102	0.4325	3.4847	0.4818	3.8957	0.4841
IEM	3.2433	0.4601	3.2289	0.4559	3.7138	0.4882
IR	3.4420	0.3883	3.3519	0.3962	3.0157	0.5287
Tests	Value	F	Between group df	Within group df	Significance of statistic, p	
Pillai's trace	0.192	6.602	6	372	0,000	
Wilks's lambda	0.809	6.899	6	370	0,000	
Roy's largest root	0.227	14.093	3	186	0,000	
CE practices	Sum of square	df	Mean square	F	Significance of statistic, p	
ECO	3.035	2	1.518	6.988	0.001	
IEM	4.303	2	2.151	10.128	0.000	
IR	2.885	2	1.442	8.584	0.000	

The MANOVA test results related to the CE-targeted performances can be seen in Table 4. Significant differences in the CE-targeted performances were also found across the three types of SME with a significant Pillai's trace value of 0.138 (p=0.000), a Wilks' lambda value of 0.866 (p=0.000), and a Roy's largest root value of 0.113 (p=0.000). This means that all the CE-targeted performances are significantly different across the three types of SME at the level of significance of 0.000 - 0.005 (see Table 4), indicating that Hypothesis 2 is strongly supported. It can be seen that the type 1 SMEs with the highest values of ESCC practices had highest values of the environmental and economic performances; whereas the type 3 SME with the lowest values of ESCC practices also had the lowest values of environmental and economic performances. The upheld of this hypothesis supports the condition that the achievement of CE-targeted performances (economic and environmental) at the company level depends on the ESCC practices conducted by the company.

Table 4 Result of MANOVA test for CE-targeted performances

MANOVA for CE targeted performances						
CE targeted performance	Type 1: ESCC Leaders (n = 64)		Type 2: ESCC Followers (n = 105)		Type 3: ESCC Laggards (n = 21)	
	Mean	Std, Dev.	Mean	Std, Dev.	Mean	Std, Dev.
ECP	2.9156	0.5378	2.8514	0.7066	2.2000	0.6419
ENP	3.3219	0.6567	3.0552	0.7694	2.5810	0.7181
Tests	Value	F	Between group df	Within group df	Significance of statistic, p	
Pillai's trace	0.138	6.934	4	374	0.000	
Wilks's lambda	0.866	6.958	4	372	0.000	
Roy's largest root	0.113	10.572	2	187	0.000	

CE targeted performance	Sum of square	df	Mean square	F	Significance of statistic, p
ECP	8.693	2	4.347	10.369	0.000
ENP	9.008	2	4.504	8.504	0.005

5.3. Moderating roles of ESCC

The result of the test on moderating effects of ESCC can be seen in Tables 6, 7, and 8. The result of regression analysis between the two dependent factors that have a moderating effect with the independent factor can seriously be distorted if there is multicollinearity. If one factor tends to have high correlations with other factors and aspects, then the standard errors can be inflated and thus the statistical significance of the regression results can also be misinterpreted (Jaccard et al. 1990). In order to investigate the possibility of multicollinearity between ESCC dimensions (GP and CC) and CE dimensions (IEM, ECO, and IR), this study calculated the value of Variance Inflation Factor (VIF) and tolerance from the regression equation between each ESCC and CE practices dimension as the independent variables to the environmental and economic performances as the dependent variables (e.g. the regression analysis between GP and ECO to environmental performance; and between GP and ECO to economic performance).

As seen in Table 5, there is no symptom of multicollinearity between GP and IEM, GP and ECO, GP and IR, CC and IEM, CC and ECO, and CC and IR, since all of the values of VIF and tolerances are less than 10 and greater than 0.1 (Hair et al, 1995; Ringle et al, 2915).

Table 5. The value of VIF and tolerance from the regression equation between the dimensions of ESCC practices and CE practices to CE-targeted performances

	VIP				Tolerance			
	ECP		ENP		ECP		ENP	
	CC	GP	CC	GP	CC	GP	CC	GP
ECO	1.062	1.005	1.062	1.005	0.942	0.995	0.942	0.995
IEM	1.051	1.024	1.051	1.024	0.952	0.977	0.952	0.977
IR	1.059	1.054	1.059	1.054	0.945	0.949	0.945	0.949

Table 6, shows that IEM and GP (Step 3) and interaction between IEM and GP (step 4) are both insignificant for the economic performance. However, the interaction between IEM and CC has a significant positive beta value (Step 4). This indicated that CC positively moderates the relationship between IEM and the economic performance at the level of significance of 0.05. The significant role of CC as a moderating dimension for the relationship between IEM and the economic performance can also be done by comparing it to the result of regression in Step 2 and Step 4. The beta values and the level of significance of IEM are strengthened, from 0.047 to 0.219 and from insignificance to significance at the level of 0.05. The implication is that if the SMEs attempt to improve their economic performance through the IEM practices, they should cooperate and collaborate with their customers. The regression analysis in Table 6 also shows that the types of enterprise have a positive significant effect on the environmental performance. The incremental F for the block of IEM and CC (Step 3) is significant for the environmental performance. The interaction between IEM and GP has negative beta value the level of significance of 0.05 whereas the IEM and CC have positive beta values at the level of significance 0.05. Compared to the result of regression in Step 3, GP practices have a role of a negative moderating dimension for the relationship between IEM and the environmental performance. Then, compared to the result of regression in Step 3, CC practices positively moderate the relationship between IEM and the environmental performance.

Table 6. Moderating effects of ESCC practices on the relationships between IEM and CE-targeted performances

	Dependent variables							
	Economic performance				Environmental performance			
Variable or dimension entered	Step 1	Step 2	Step 3	Step 4	Step 1	Step 2	Step 3	Step 4
Type of enterprises	0.024	0.018	0.004	0.012	0.148*	0.132	0.113	0.126
IEM		0.047	0.099	0.141		0.132	0.194*	0.263*
GP			0.013	0.021			0.036	0.052
CC			0.219*	0.169			0.244*	0.163
IEM X GP				-0.118				-0.200*
IEM X CC				0.219*				0.358*
F for the regression	0.107	0.254	2.541*	2.399*	4.218*	3.806*	5.617*	5.975*
R^2	0.001	0.003	0.052	0.073	0.022	0.390	0.108	0.164

Table 7 indicated that the ECO has a positive significant effect on the economic performance. Compared with the regression result in Steps 3 and 4, the relationship between ECO and GP has resulted in a negative beta value, whereas the relationship between ECO and CC has a positive beta value, both at the level of significance of 0.05. In this case, GP practices have a negative moderating effect on the relationship between ECO and the economic performance. Furthermore, the result of regression in Table 7 also indicated that CC practices have a positive moderating effect on the relationship between ECO and the economic performance. This shows that type of SMEs has a positive significant effect on the environmental performance. ECO practices have a significant effect on the environmental performance. Compared to the result of regression in Steps 3 and 4, both GP and CC practices, have a positive moderating role for the relationship between ECO and the environmental performance.

Table 7. Moderating effects of ESCC practices on the relationship between ECO and CE-targeted performances

	Dependent variables							
	Economic performance				Environmental performance			
Variable or dimension entered	Step 1	Step 2	Step 3	Step 4	Step 1	Step 2	Step 3	Step 4
Type of enterprises	0.024	0.002	-0.010	-0.002	0.148*	0.122	0.106	0.114
ECO		0.188*	0.257*	0.296*		0.228*	0.304*	0.345*
GP			-0.032	-0.012			-0.019	0.137
CC			0.291*	0.248*			0.313*	0.109*
ECO X GP				-0.240*				0.234*
ECO X CC				0.313*				0.194*
F for the regression	0.107	3.436*	5.341*	5.772*	4.218*	7.380*	8.653*	9.515*
R^2	0.001	0.035	0.104	0.159	0.022	0.073	0.158	0.238

Table 8 indicated that IR practices have a positive significant effect on the economic performance. Compared with the results of regression in Step 3 and Step 4, the interaction between IR and GP has negative beta value at the level of significance of 0.05 whereas, the interaction between IR and CC is insignificant. GP practices have a negative moderating role for the relationship between IR and the economic performance. With regard to the environmental performance, the results of regression in Step 2 indicated that this type of SMEs has a positive significant effect on the environmental performance. IR practices have a significant effect on the environmental performance. Compared with the result of regression in Step 3 and Step 4, GP practices have a negative moderating role for the relationship between IR and the environmental performance.

Table 8. Moderating effects of ESCC practices on the relationship between IR and CE-targeted performances

	Dependent variables							
	Economic performance				Environmental performance			
Variable or dimension entered	Step 1	Step 2	Step 3	Step 4	Step 1	Step 2	Step 3	Step 4
Type of enterprises	0.024	0.003	0.006	0.006	0.148*	0.127*	0.127	0.135*
IR		0.104*	0.430*	0.431*		0.465*	0.437*	0.420*
GP			-0.040	-0.087			0.132	-0.065
CC			0.133	0.144			0.104	0.148
IR X GP				-0.264*				-0.191*
IR X CC				0.150				0.214
F for the regression	0.107	24.069*	12.752*	10.386*	4.218*	29.121*	15.591*	11.827*
R^2	0.001	0.205	0.216	0.254	0.022	0.237	0.252	0.279

Based on Tables 6, 7 and 8, we can conclude that Hypothesis 3 is not fully supported. Not all interactions between CE practices and ESCC gave a positive significant effect on CE-targeted performances (ECP and ENP). In this case, the interaction between IEM and CC, and ECO and CC, have a positive significant effect on the economic performance; whereas, the interaction between IEM and CC, ECO and CC, and ECO and GP have a positive significant effect on the environmental performance. In this circumstance, it can be said that CC moderates the relationship between IEM and the economic performance and between IEM and the environmental performance; CC also moderates the relationship between ECO and the economic performance and between ECO and the environmental performance. GP only moderates the relationship between ECO and the environmental performance.

Although the partial correlation between GP and CE-targeted performances (ECP and ENP) is significantly positive (see Table 9), surprisingly, the GP did not show any moderation effect to the relationship between ECO and IR on the economic performance. The relationships between GP and ECO, and GP and IR, have a negative significant effect on the economic performance. A plausible explanation to this is that, though GP can improve the implementation of reuse and recycling through the green purchasing, but the more effective green purchasing implementation will significantly reduce waste, and ECO and IR practices become less significant to the economic performance. Similarly, both IEM and IR in theory can improve the implementation of reuse and recycling, but if the green purchasing implementation is effective, then it consequently will reduce waste, and thus, IEM and IR practices become rather trivial to the environmental performance.

Table 9. The result of partial correlation analysis between ESCC and CE practices to the CE-targeted performances

	ECP	ENP
ECO	0.188**	0.242**
IEM	0.049	0.148*
IR	0.049	0.148*
CC	0.207**	0.230**
GP	0.149*	0.191**

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

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6. Conclusions

This study has revealed that the implementation of ESCC has indeed varied across the SMEs under study. This variation is believed to have been related to the variety in CE practices and, thus, the CE-targeted performances. The variation in ESCC practices has led to the three groups of ESCC practitioners within the Indonesian wooden furniture industry: the ESCC leaders, followers and laggards. Although the clustering is somewhat different from that of Zhu et al (2010) and Botezat et al (2018), our findings confirmed the positive correlation between CE-targeted performances and the implementation of ESCC practices.

The CE practices and CE-targeted performances differ significantly across the three groups of SMEs. Some of the interactions between ESCC and CE practices exhibit a positive effect on CE-targeted performances. In this case, collaboration with customers improves the impact of the internal environmental management (IEM) and eco-design (ECO) to economic and environmental performances; whereas, collaboration with the supplier through green purchasing (GP) can only improve the effect of eco-design (ECO) to the environmental performance. However, this does not mean the interaction between ESCC and CE practices is not significant to the CE-targeted performances. In this study, the high level of green purchasing (GP) implementation has proven its effectiveness in reducing waste significantly, which subsequently makes the implementation of eco-design (ECO) and internal recovery (IR) less significant to the economic improvement and, similarly, the implementation of the internal environmental management (IEM) and internal recovery (IR) is rather insignificant to the environmental performance.

The roles of green purchasing (GP) as a moderating factor for the relationships between the eco-design (ECO) or internal recovery (IR) and the economic performance, and the roles of green purchasing (GP) as a moderating factor for the relationships between internal environmental management (IEM) or internal recovery (IR) with the environmental performance, do not seem to be extensively discussed in the literature, except the individual impact of green purchasing practices on the economic and environmental performances (Wisner et al, 2012). The latter can be found in Wu (2008), Min and Gale (2001), Zsidin and Siferd (2001) and ElTayeb et al (2010). Companies that practiced the environmental strategy in purchasing typically benefit from cost savings, better public image and reduced liability (Wisner et al., 2012). The green purchasing aims to minimize negative environmental impacts in manufacturing process and transportation by using durable, recyclable and reusable materials (Sarkar, 2012). Moreover, since the green purchasing will involve the collaboration with the supplier, Hollos et al. (2012) argue that in order to get a better environmental performance, supplier collaboration should be combined with internal green supply chain management efforts. Other research discussing the roles of collaboration with customers as a moderating factor appears to be lacking.

Nonetheless, the result of the study conducted by Laari (2016) revealed that internal green supply chain alone is insufficient to improve the economic performance, and the companies will need to extend their focus beyond their organizational boundaries and reach out to their customers. Customer collaboration combined with internal green supply chain management is thus believed to be the most effective way to improve the economic performance. According to Azevedo et al. (2011) and Zhu et al (2013), customer collaboration with respect to addressing the environmental issues could either directly generate economic benefits, or indirectly, through environmental or operational performances. Environmental collaboration with customers may reduce waste in their businesses and environmental costs, increase customer satisfaction, and simultaneously maximize the return volumes.

From this study, we learnt that the traditional wooden furniture industry in Indonesia should be better-off implementing the ESCC practices if they seek to improve their performances through CE practices. For instance, they can collaborate with their customers to improve both economic and environmental performances through IEM and ECO practices. They can also embark on the green purchasing (GP) initiatives with their suppliers to improve the environmental performance through eco-design (ECO). Considering the roles of GP and CC as the moderating factor, it is crucial that the wooden furniture industry collaborate with their suppliers and customers simultaneously. The CE practices alone are found insufficient in improving the economic and environmental performances; the wooden furniture industry will need to extend their focus beyond individual companies. Moreover, to succeed in implementing the ESCC and CE practices, SMEs need three types of innovation (technology, management, and marketing). In this case, according to the result of research conducted by Zhu et al (2019), technology innovation and management innovation can help the SMEs to improve environmental performance together with workers involvement, and marketing innovation can help the SMEs to improve environmental performance through community involvement

This study has several implications for the government and policymakers. First, to reduce the negative impacts of wood waste from the furniture industry, the government can promote the ESCC practices within the SMEs in order to increase the uptake of CE practices and, thus, the CE-targeted performances. Second, the government could embrace the leading SMEs (those whose ESCC levels are high) as champions and being exemplar of good practices to other SMEs. Third, the government and policymakers should support the SMEs with a quality standard or a certification system for reuse and remanufacturing of furniture products for success in implementing IEM practices that involve reuse and remanufacturing furniture products from wood waste or expired product. According to the research conducted by Shi et al (2018), lack of quality standards or certification systems for remanufacturing products become one of the main obstacles for successful of the implementation of remanufacturing program or closed-loop supply chain.

This study has some limitations. First, it is arguable that the CE-targeted performances are only measured by the Likert scales that are inherently prone to bias and inconsistency from the respondents expressing the level of performances achieved by their SMEs. Future research may take the benefits of inducing the qualitative approaches to better measure the CE-targeted performances via observation and probing (in addition to measuring the perception of it). Second, as this study did not consider the roles of ESCC practices as a mediating factor for the relationship between CE practices and CE-targeted performances, it offers limited knowledge on the direct and indirect effects of CE on its targeted performances, i.e. whether the CE can truly influence the CE-targeted performances directly, or whether the CE-targeted performances can be achieved only after the SMEs successfully implement the ESCC practices.

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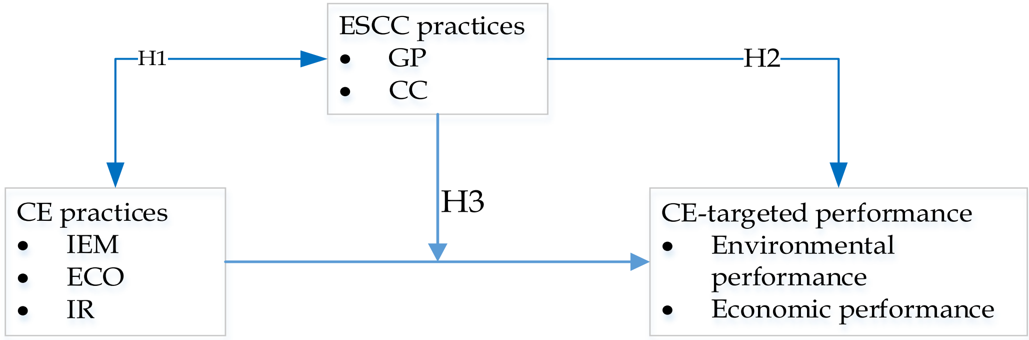

IEM = internal environmental management; ECO = eco-design; IR = internal recovery; GP = green purchasing; CC = customer cooperation.

Figure 1. The conceptual model showing the relationship between ESCC practices, CE practices, and CE-targeted performances

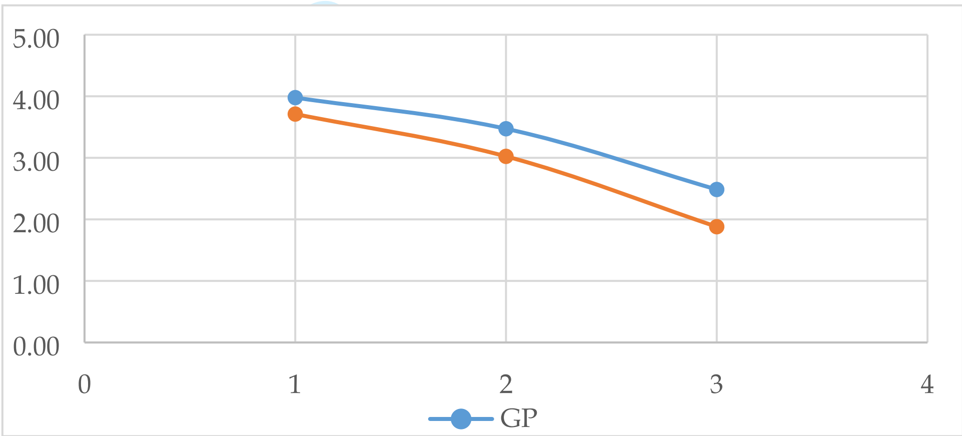

Figure 2. ESCC practices for each type of SME

Table 1. Measurement Items of GP, CC, IEM, ECO, IR, ECP and ENP

Dimension	Measurement items	Item-total correlation	Cronbach's alpha values
Green Purchasing (GP)	• Policy that suppliers must provide legal timber (GP1) • Policy that suppliers must provide wood that has expired (GP2) • Cooperate with suppliers of wood that have expired for differentiating furniture products (GP3) • Cooperate with suppliers of wood that have expired for manufacturing by-products (GP4) • Cooperate with suppliers to supply additional materials that are not harmful to the environment (GP5)	0.148-0.558 (low to high)	0.664
Collaboration with customer (CC)	• Working with consumers to design furniture products that are easy to re-use, remanufacture, and recycle. (CC1) • Communicate to consumers so that they do not object to furniture products that come from wood material that has expired. (CC2) • Cooperate with consumers to establish a special system for collecting used (used) furniture products so that it can be used as alternative furniture products (CC3) • Cooperate with consumers to establish a special system for collecting used (used) furniture products so that they can be made as a by-product (CC4)	0.508-0.694 (high)	0.796
Internal environmental management (IEM)	• Implement reuse, recycle, and remanufacture practices on waste wood management with the owner's commitment (IEM1) • Implement reuse, recycle, and remanufacture practices on waste wood management with the support of workers (IEM2) • The involvement of all workers in the practice of reuse, recycle, and remanufacture the management of wood waste (IEM3) • Willingness to accept suggestions from the workers to improve the implementation of reuse, recycle, and remanufacture in the process of managing wood waste (IEM4) • Providing training to increase environmental awareness of wood waste management (IEM5). • Special training on knowledge and skills in managing wood waste (IEM6) • Discussion of wood waste management activities in evaluating the performance of internal business units (IEM7)	0.329-0.555 (medium to high)	0.777
Eco-design (ECO)	• Use recycle of wood for making a new furniture (ECO1) • Application of policies to produce furniture products whose wood materials / components can be reused (ECO2)	0.496-0.655 (medium to high)	0.834

Dimension	Measurement items	Item-total correlation	Cronbach's alpha values
	• Policy for producing furniture products where the wood component material used can be reused (ECO3) • Policy for producing furniture products where wood component materials used can be remanufactured • Avoid the consumption of hazardous additives in the design of furniture products. • Reduce the consumption of hazardous additives in the design of furniture products • Application of production processes that can minimize wood waste • Application of production processes that can minimize products, components, and material defects		
Internal recovery (IR)	• Policy to sell excess wood inventory / material (IR1) • Policy for selling defective wood products, components or materials (IR2) • Policy for selling the wood waste (IR3) • Policy to collect and recycle wood from furniture products / materials that have expired (used) (IR4) • Policy to establish a recycle system of used furniture products / materials (IR5) • Policy to establish a recycle system from defective furniture products (IR6)	0.118-0.494 (low to medium)	0.601
Economic performance (ECP)	• Increase in percentage of income due to activities from wood waste management activities (ECP1) • Decrease in percentage of cost due to purchase a new wood (ECP2) • Decrease in percentage of costs due to defective furniture component / material (ECP3) • Decrease in percentage of costs due to excess wood inventory (ECP4) • Decrease in percentage of costs due to wood waste disposal (ECP5)	0.440-0.584 (medium to high)	0.749
Environmental performance (ENP)	• Increase the percentage of recycle wood used in production process (ENP1) • Increase the percentage of wood waste being processed with recycle method (ENP2) • Increase the percentage of wood waste being processed with the other methods –reuse, remanufacture (ENP3) • Decrease the percentage of wood waste being processed with incineration method (ENP4) • Decrease the amount of wood waste stored by the enterprises (ENP5)	0.440-0.639 (medium to high)	0.760

Table 2. The result of statistical test from the CFA of ESCC practices, CE practices, and CE-targeted performances

Construct	Cut-off value	Normed χ2	RMSEA	CFI	GFI
ESCC practices	**Normed χ2** Normed χ2 close to 1.00→ a good fit Normed χ2 less than 2.00 or 3.00→ an adequate fit **RMSEA** RMSEA≤0.05→ a good fit; 0.05<RMSA≤0.08 →an adequate fit; 0.08<RMSA≤0.1→ mediocre fit **CFI** CFI>0.9 → a good fit **GFI** GFI≥ 0.95 → a good fit; 0.8≤GFI<0.95→ a marginal fit.	1.807 (good fit)	0.065 (adequate fit)	0.912 (good fit)	0.883 (marginal fit)
CE practices		2.719 (adequate fit)	0.095 (mediocre fit)	0.952 (good fit)	0.954 (good fit)
CE-targeted performances		1.859 (good fit)	0.067 (adequate fit)	0.956 (good fit)	0.946 (good fit)

Table 3 Results of MANOVA test for CE Practices

MANOVA for CE practices						
CE practices	Type 1: ESCC Leaders (n = 64)		Type 2: ESCC Followers (n = 105)		Type 3: ESCC Laggards (n = 21)	
	Mean	Std, Dev.	Mean	Std, Dev.	Mean	Std, Dev.
ECO	3.5102	0.4325	3.4847	0.4818	3.8957	0.4841
IEM	3.2433	0.4601	3.2289	0.4559	3.7138	0.4882
IR	3.4420	0.3883	3.3519	0.3962	3.0157	0.5287
Tests	Value	F	Between group df	Within group df	Significance of statistic, p	
Pillai's trace	0.192	6.602	6	372	0,000	
Wilks's lambda	0.809	6.899	6	370	0,000	
Roy's largest root	0.227	14.093	3	186	0,000	
CE practices	Sum of square	df	Mean square	F	Significance of statistic, p	
ECO	3.035	2	1.518	6.988	0.001	
IEM	4.303	2	2.151	10.128	0.000	
IR	2.885	2	1.442	8.584	0.000	

Table 4 Result of MANOVA test for CE-targeted performances

MANOVA for CE targeted performances						
CE targeted performance	Type 1: ESCC Leaders (n = 64)		Type 2: ESCC Followers (n = 105)		Type 3: ESCC Laggards (n = 21)	
	Mean	Std, Dev.	Mean	Std, Dev.	Mean	Std, Dev.
ECP	2.9156	0.5378	2.8514	0.7066	2.2000	0.6419
ENP	3.3219	0.6567	3.0552	0.7694	2.5810	0.7181
Tests	Value	F	Between group df	Within group df	Significance of statistic, p	
Pillai's trace	0.138	6.934	4	374	0.000	
Wilks's lambda	0.866	6.958	4	372	0.000	
Roy's largest root	0.113	10.572	2	187	0.000	
CE targeted performance	Sum of square	df	Mean square	F	Significance of statistic, p	
ECP	8.693	2	4.347	10.369	0.000	
ENP	9.008	2	4.504	8.504	0.005	

Table 5. The value of VIF and tolerance from the regression equation between the dimensions of ESCC practices and CE practices to CE-targeted performances

	VIP				Tolerance			
	ECP		ENP		ECP		ENP	
	CC	GP	CC	GP	CC	GP	CC	GP
ECO	1.062	1.005	1.062	1.005	0.942	0.995	0.942	0.995
IEM	1.051	1.024	1.051	1.024	0.952	0.977	0.952	0.977
IR	1.059	1.054	1.059	1.054	0.945	0.949	0.945	0.949

Table 6. Moderating effects of ESCC practices on the relationships between IEM and CE-targeted performances

	Dependent variables							
	Economic performance				Environmental performance			
Variable or dimension entered	Step 1	Step 2	Step 3	Step 4	Step 1	Step 2	Step 3	Step 4
Type of enterprises	0.024	0.018	0.004	0.012	0.148*	0.132	0.113	0.126
IEM		0.047	0.099	0.141		0.132	0.194*	0.263*
GP			0.013	0.021			0.036	0.052
CC			0.219*	0.169			0.244*	0.163
IEM X GP				-0.118				-0.200*
IEM X CC				0.219*				0.358*
F for the regression	0.107	0.254	2.541*	2.399*	4.218*	3.806*	5.617*	5.975*
R^2	0.001	0.003	0.052	0.073	0.022	0.390	0.108	0.164

Table 7. Moderating effects of ESCC practices on the relationship between ECO and CE-targeted performances

	Dependent variables							
	Economic performance				Environmental performance			
Variable or dimension entered	Step 1	Step 2	Step 3	Step 4	Step 1	Step 2	Step 3	Step 4
Type of enterprises	0.024	0.002	-0.010	-0.002	0.148*	0.122	0.106	0.114
ECO		0.188*	0.257*	0.296*		0.228*	0.304*	0.345*
GP			-0.032	-0.012			-0.019	0.137
CC			0.291*	0.248*			0.313*	0.109*
ECO X GP				-0.240*				0.234*
ECO X CC				0.313*				0.194*
F for the regression	0.107	3.436*	5.341*	5.772*	4.218*	7.380*	8.653*	9.515*
R^2	0.001	0.035	0.104	0.159	0.022	0.073	0.158	0.238

Table 8. Moderating effects of ESCC practices on the relationship between IR and CE-targeted performances

	Dependent variables							
	Economic performance				Environmental performance			
Variable or dimension entered	Step 1	Step 2	Step 3	Step 4	Step 1	Step 2	Step 3	Step 4
Type of enterprises	0.024	0.003	0.006	0.006	0.148 *	0.127*	0.127	0.135*
IR		0.104*	0.430*	0.431*		0.465*	0.437*	0.420*
GP			-0.040	-0.087			0.132	-0.065
CC			0.133	0.144			0.104	0.148
IR X GP				-0.264*				-0.191*
IR X CC				0.150				0.214
F for the regression	0.107	24.069*	12.752*	10.386*	4.218*	29.121*	15.591*	11.827*
R^2	0.001	0.205	0.216	0.254	0.022	0.237	0.252	0.279

Table 9. The result of partial correlation analysis between ESCC and CE practices to the CE-targeted performances

	ECP	ENP
ECO	0.188**	0.242**
IEM	0.049	0.148*
IR	0.049	0.148*
CC	0.207**	0.230**
GP	0.149*	0.191**

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

REVIEWER: 1

Comments to the Author
Nice job on the revision. You have resolved all of my original concerns.

REVIEWER 2

No	Reviewer's suggestion	Response
1	Some recent related publications should be included. Examples are: Liu et al. (2018) 'Green supply chain management and the circular economy: Reviewing theory for advancement of both fields', International Journal of Physical Distribution & Logistics Management, 48(8): 794-817. Shi et al. (2019) 'Barriers of a closed-loop cartridge remanufacturing supply chain mode for urban waste recovery governance in China', Journal of Cleaner Production, 212: 1544-1553. Zhu et al. (2019) 'The role of innovation for performance improvement through corporate social responsibility practices among small and medium-sized suppliers in China', Corporate Social Responsibility and Environmental Management, 26:341–350.	Thank you for your suggestion. We have cited and added the result of research from Liu et al (2018), Shi et al (2019), and Zhu et al (2019) in the article. Please check the red sentences in first paragraph in the section 2.1. Please check the red sentences in fifth and sixth paragraph in the section 5.
2	Additionally: • Please consider including H1 into the conceptual model • H1 should read "CE practices are positively correlated to ESCC practices" • H2 should read "ESCC practices are positively correlated to CE-targeted performance".	We have included H1 into the conceptual model and change the sentences in Hypothesis 1 (H1) and Hypothesis 2 (H2) as your suggesstion.