

# **Assessing Circular Economy Barriers in Indonesian Furniture Industry**

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## **Abstract**

The furniture industry has great contributing for Indonesia. However, its operational activities cause environmental damage caused by waste and scarcity of raw materials. Currently, the linear economy applied by most of the furniture industry is unable to solve this problem. Circular economy entered as a restorative or regenerative concept that can optimize resources and minimize waste. In the process of transition from linear economy to a circular economy, there are barriers to its implementation. This research was conducted to evaluate the barriers in the implementation of circular economy in the furniture industry and then determine factors that have a significant influence as barriers to the circular economy in furniture industry. After obtaining the results in the form of factors that have a significant influence, strategic recommendations are proposed to the government and furniture industry. The method used in this research is cut off point method and the Fuzzy DEMATEL method. Respondents of this study consisted of the government, furniture industry, community, and academia. The results showed that government policies, poor of management commitment, lack of knowledge, lack of coordination and collaboration, economic / financial challenges, lack of resources, consumer awareness, and lack of skills are the most influential barrier factors in implementation of circular economy in furniture industry. Some strategies were proposed to overcome the barrier in implementing circular economy in furniture industry.

## **Keywords**

Circular Economy, Barriers, Furniture, Strategy and Fuzzy DEMATEL

## **1. Introduction**

The furniture industry is the industrial sector which has an important role for the economy of Indonesia. This is because the furniture industry has a great potential in the domestic trade and international trade. The development of the furniture industry in Indonesia is inseparable from the support of Indonesia's natural resources. Various issues related to the availability of raw materials in the form of wood and the prices are getting more expensive as a result of the destruction of Indonesia's forests are still experienced by entrepreneurs in today's furniture. The problem of forest destruction not only have an impact on the industrial sector, but also it will bring huge negative impact on the environment (Widodo et al. 2010).

Another problem faced by industrial furniture that is about the environmental impact resulting from the waste of the production process. The composition of waste wood in the industrial sawmill includes sawdust and 10.6%, snippet 25,9% and pieces of 14.3%, with a total waste of 50.8% of the amount of the raw material wood log used (Purwanto 1994). Other studies also mention that during the processing of furniture, there are at least 7% and at most 50% of the supply of wood raw material annual will be the residue (Daian and Ozarska 2009).

In LAW No. 32 year 2009 article 1 paragraph (2) has been arranged that the need to attempt a systematic and integrated is done to preserve the function of the environment and prevent pollution and/or damage to the environment which includes planning, utilization, control, maintenance, supervision, and law enforcement. Therefore, the development of a sustainable industry into the important things to do. To follow up and strengthen in building a green industry, the government issued government regulation No. 29 year 2018 about the empowerment of the industry which is set regarding the standardization of the green industry.

The concept of circular economy (CE) entered as an idea of the approach in an industrial system that is designed to be restorative or regenerative (EMF 2016). CE describe the economic system that is based on a business model that replaces the concept of 'end-of-life' with the reduce, reuse, and recycle (Kirchherr et al. 2012; Kristina et al. 2018). At first the principle of the 3RS (reduce, reuse, recycle) to be the embodiment dominant in the implementation of the CE, but the last few years, the approach 6R said to be more relevant in carrying out the practice of circular economy with the added concept recover, redesign and remanufacture (Govindan and Hasanagic 2018). This has the aim to preserve natural resources through the replacement of the product with the design of the items that can be used repeatedly. There are 3 simple principles of the model of circular economy, namely the design of the waste and pollution that fit in the product cycle biosphere or the techno sphere, the maintenance of products, components and materials that remain in use in the system of production as long as possible, as well as regenerate on natural ecosystems (EMF 2013). The practice of implementation of the circular economy can be done in 3 different levels, namely the micro level, the level of meso and the macro level (Maqbool et al. 2020).

The furniture industry including one of the sectors that adopted by the circular economy (Mhtre et al. 2020; Wicaksono and Kadafi 2020). However, most of the furniture industry still follows the concept of economic linear, where the products are made from raw materials of pure, converted into finished products and finally disposed of as waste (Braungart et al. 2007). A linear economy which is carried out continuously will have an impact is very bad for the environment (Korhonen et al. 2017). The application of circular economy can be an alternative to improve economic system with linear production model of "take-make-distribute-consume-dispose" into "take-make-distribute-consume-return" (Wicaksono et al. 2020). The application of CE not only provide benefits for the environment, however, give a big impact for the company, among other cost-efficiency, energy saving, reduction of waste generated as well as the possible benefits of employment for the economy (EMF 2013).

In the process of transition from a linear economy towards a circular economy, there are obstacles in the implementation. This is due to the unpreparedness of the businesses in the start and accept the risk when applying the concept of circular economy (Tonelli and Cristoni 2019). Most businesses that they run do not implement the system return to the consumer. Re-use of furniture products "second-hand" or recycling still tend to be in a small scale so that a positive impact is generated for the economy and the environment is also small. Some of the factors that become obstacles in the application of the CE that is less robust rules and regulations, the economy, culture, technology, knowledge, the limitations of competent human resources, etc. The transition towards a CE requires the transformation of a large enough related to the design, production, consumption, waste management, reuse and recycling (Hobson 2015). The role of stakeholders, namely consumers, government, business owners, suppliers, researchers, and workers become factors that affect the effectiveness of the application of the circular economy to support each other and collaborate in order to achieve sustainable development.

The objectives of this research are identify barrier factors that can obstruct the circular economy implementation than assess the barrier factor so we can determine the rank of the barrier factor for implementing circular economy. The final result of this study is factors that could potentially hinder the implementation of circular economy in particular industrial furniture and suggest the strategies to overcome circular economy barrier in furniture industry. The research will use the approach of Fuzzy Decision Making Trial and Evaluation Laboratory (Fuzzy DEMATEL). The use of Fuzzy DEMATEL will help to identify the inhibiting factors which will then be compiled strategy of the application of the circular economy are addressed to governments and businesses based on the inhibiting factors are the most influential.

## **2. Literature Review**

Circular economy is a restorative or regenerative industrial system that aims to maintain a product and components and materials have the highest usability and value all the time (EMF 2013). Circular economy concept can be implemented on biological and technical aspects. Circular economy changes the concept of 'end-of-life' with the concept of recovery that aims to eliminate waste through superior design of materials, products, systems and business models. In circular economy, industrial waste or waste is used as a valuable input where waste can be repaired, reused and recycled using cost-effective waste management techniques, producing value-added products and processes, and economically added value (Granek 2011; Crowther and Gilman 2014). Circular economy aims to use the resources taken for as long as possible and to perform product or material recovery and repair at the end of the product lifecycle (Brears 2018).

There are 17 variables that identified from previous research related to the barriers in implementing circular economy. They include government policies; poor of management commitment; lack of coordination and collaboration; economic/ financial challenges; profit and market demand; lack of skill; lack of knowledge; consumer awareness; perception about circular product; technological limitations; quality of product; design challenges; waste management; lack of resource; return flows uncertainty; lack of information and lack of standard. The barriers can be seen in table 1.

Table 1. Barrier Variables

Barriers	Sources	Definition
Government policies	(Govindan and Hasanagic 2018; Agyemang et al 2019)	Government policies on applicable laws and regulations are still weak, lack of support and motivation from the government and incentives.
Poor of management commitment	(Govindan and Hasanagic 2018)	Poor management including a lack of commitment and support from top management to make changes to the circular economy.
Lack of coordination and collaboration	(Mangla 2018)	The low collaboration between stakeholders and other companies has resulted in difficulty in coordinating in achieving common goals.
Economic/ Financial Challenges	(Govindan and Hasanagic 2018; Zhang et al. 2019) [7; 24]	Cost and financial constraints include investment costs, the cost of purchasing materials and packaging of environmentally friendly products and very high production costs. Financial problems for waste management.
Profit and market demand	(Zhang et al. 2019)	The lack of concern for the environment and preference for recycled products, makes the company experience uncertainty of market demand and profit earned.
Lack of skill	(Agyemang et al 2019)	Companies do not have the skills to make the transition from linear economy to circular economy.
Lack of knowledge	(Zhang et al. 2019)	The application of circular economy concept requires high knowledge. This resulted in limitations in adopting circular product design and network to promote CE implementation.
Consumer awareness	(Govindan and Hasanagic 2018)	There is still a lack of consumer awareness regarding the implementation of circular economy principles.
Perception about circular product	(Govindan and Hasanagic 2018)	Consumers have misperceptions about reused/recycled products and question about the quality, health and safety of the use of such products.
Technological limitations	(Govindan and Hasanagic 2018)	Limitations in adopting advanced and relevant technology.
Quality of product	(Govindan and Hasanagic 2018)	Difficulty maintaining product quality throughout its life cycle for as long as possible and maintaining the quality of recovered materials.
Design challenges	(Govindan and Hasanagic 2018)	Problems in designing products that are sustainable (durable), reusable (reuse), easy to disassembly, reprocessing products in the original or new form (remanufacture) and reuse (recovery).
Waste management	(Govindan and Hasanagic 2018; Agyemang et al 2019)	Inability of the company to use all end-of-life products for production purposes or lack of waste management.
Lack of resource	(Agyemang et al 2019)	Lack of availability of resources including natural resources, organization, finance, access to capital and availability of funds. Challenges of availability and quality of recycled materials are limited.
Return flows uncertainty	(Agyemang et al 2019; Bressanelli et al. 2019)	The take-back program allows consumers to return their expired products. However, most of the products that have been sold, will never be returned again. Uncertainty about the quantity, quality, time and place of return of the final product complicates capacity planning.

Lack of information	(Govindan and Hasanagic 2018; Agyemang et al 2019)	Lack of information and guidelines on how to maintain and repair furniture, and extend product life. Therefore, it is difficult to reuse/recycle/recycle remanufacture on the product.
Lack of standard	(Govindan and Hasanagic 2018; Zhang et al. 2019)	There are no definite standard requirements regarding CE processes, activities, materials such as waste management, specifications for recycled materials, refurbished products and products to be reused.

### 3. Methods

The method of data collection is a communication study where the researcher will ask questions or give questionnaires to the respondents. The researcher does not have control over the variables so that the researcher is not able to manipulate. The purpose of this research is causal explanatory, where this study is used to show causal relationships between variables. This research is conducted in cross sectional where the questionnaires distribution to respondents is carried out during a certain period.

The study used two types of questionnaires in data collection. The first questionnaire contains about the validation questionnaire of barrier factors. The validation process is done by using the Cut Off Point method (Tam and Tummala 2001). The purpose of validation is to determine whether the factors used are relevant to the existing conditions of the furniture industry. In conducting an assessment on each factor, respondents will use a 5-point scale (1 = very unimportant, 2 = unimportant, 3 = neutral, 4 = important, 5 = very important). The overall average values of each factor are then sorted to be searched for the largest and smallest values. Factors that have a value below the natural cut off point will be removed from the model to be used. After the validation process, a second questionnaire containing the assessment of the relationship between barriers factors will be processed using the Fuzzy DEMATEL method (Jiang et al. 2020). Respondents were asked to give an assessment using a linguistic scale (NO= no influence, VL= very low influence, L= low influence, H= high influence, VH= very high influence).

The selection of respondents is done by considering the experience or knowledge possessed to create valid results. In the decision-making system, respondents make an assessment depending on their experience and knowledge in their field. The number of respondents for the DEMATEL technique ranges between three and nine respondents.

We had 8 expert respondents in this study. The respondents were 1 respondent from the government, 1 respondent from the Indonesian Furniture and Handicraft Industry Association (ASMINDO), 1 respondent as an academician, and 5 respondents as representatives from the furniture industry. All respondent were given questionnaires and the researcher asked open questions to the respondents.

The selection of respondents in this study was conducted by sampling using purposive sampling method which is one of the non-random sampling techniques. Respondent criteria include understanding the conditions or having knowledge of the furniture industry; understand the implementation of the circular economy concept in the furniture industry; have work experience 5-10 years or more. The selected research object is furniture industry in Central Java Indonesia.

## 4. Results and Discussion

### 4.1 Cut Off Point

The factors used in this study were obtained from the calculation results with natural cut off points. Factors that have values below the COP value will not be used in this study. The results of the Cut Off Point method state that there are two research factors that are less relevant as factors that hinder the implementation of circular economy in the furniture industry, namely lack of information and lack of standard. Where each of these factors has a natural cut off point value below 4. Therefore, these two factors will not be used in the next stage of data processing using the Fuzzy DEMATEL method.

### 4.2 Fuzzy DEMATEL

Based on valid factors, relationships between criteria are searched using Fuzzy DEMATEL method. The calculation results of prominence and relation shown in Table 2. Then, Figure 1. referred to as causal diagrams that show plot data from the R+C and R-C values defined in Table 2. Causal diagrams are formed by mapping vectors (R+C, R-C).

The prominence vector (R+C) is used to look at the importance of barriers factors to the implementation of circular economy. While the relation vector (R-C) groups develop all barrier factors into cause groups and effect groups. Cause group factor is vital because of its direct impact on other factors. Government policies rank 1<sup>st</sup> based on R-C calculation with a value of 1,410. A country needs policies related to taxation, incentives, funding and strong regulations on environmental issues in adopting the circular economy concept.

The factor that ranked 2<sup>nd</sup> in the cause group is poor management commitment (poor management commitment) R-C value of 1,188. The lack of understanding by the manager about the concept of circular economy resulted in the lack of encouragement of workers to practice circular economy.

The next factor included in the cause group is lack of knowledge with the 3<sup>rd</sup> rank based on the calculation of R-C of 0.750. There are still many organizations that do not have knowledge of environmental issues and information on sustainable manufacturing practices. This factor results in no need to apply the circular economy concept.

Table 2. Prominence and Relation

Barriers	R	C	R+C	R-C	Cause / Effect
Government policies (B1)	7,697	6,287	13,985	1,410	<i>Cause</i>
Poor of management commitment (B2)	7,485	6,297	13,782	1,188	<i>Cause</i>
Lack of coordination and collaboration (B3)	6,727	6,092	12,818	0,635	<i>Cause</i>
Economic/ financial challenges (B4)	7,122	6,784	13,906	0,338	<i>Cause</i>
Profit and market demand (B5)	6,780	7,095	13,875	-0,315	<i>Effect</i>
Lack of skill (B7)	6,601	6,392	12,993	0,209	<i>Cause</i>
Lack of knowledge (B8)	7,259	6,509	13,768	0,750	<i>Cause</i>
Consumer awareness (B9)	6,912	6,689	13,601	0,223	<i>Cause</i>
Perception about circular product (B10)	6,604	6,989	13,593	-0,384	<i>Effect</i>
Technological limitations (B11)	6,515	7,204	13,719	-0,689	<i>Effect</i>
Quality of product (B13)	6,624	7,601	14,225	-0,977	<i>Effect</i>
Design challenges (B14)	5,865	7,003	12,868	-1,138	<i>Effect</i>
Waste management (B15)	6,508	7,077	13,586	-0,569	<i>Effect</i>
Lack of resource (B16)	6,597	6,285	12,882	0,313	<i>Cause</i>
Return flows uncertainty (B17)	5,799	6,790	12,589	-0,991	<i>Effect</i>

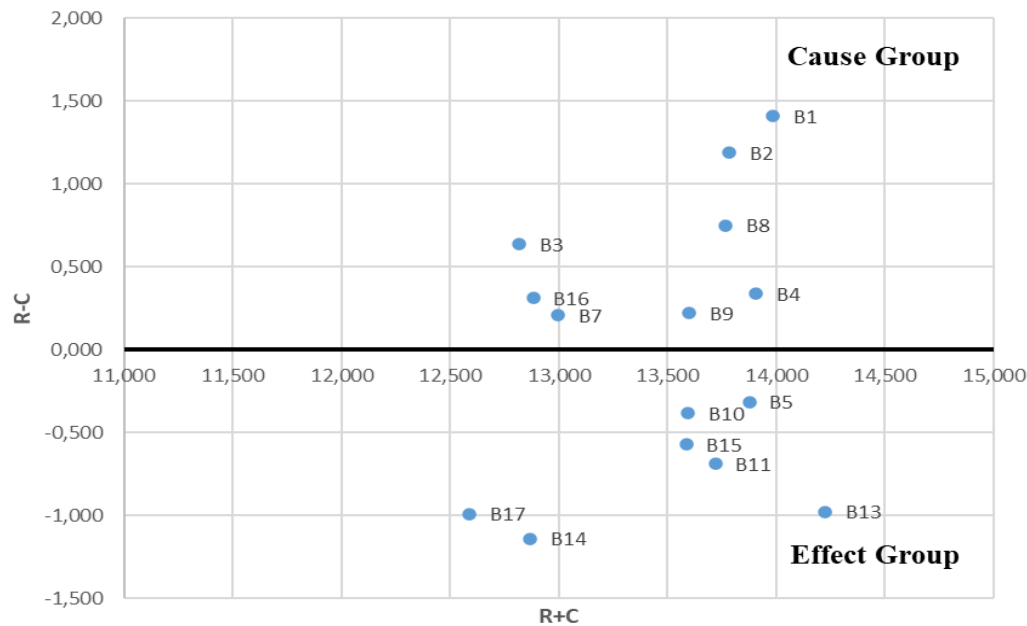


Figure 1. Causal Diagram

The next factor is lack of coordination and collaboration. This factor ranks 4<sup>th</sup> based on the calculation of R-C with a value of 0.635. Low collaboration or cooperation that occurs between stakeholders and companies resulting in difficulty in coordinating in the circular economy practices improvement.

Economic/financial challenges ranked 5<sup>th</sup> in the cause group based on R-C value of 0.338. To make the transition to circular economy, investment is required at a high cost for the company. If the organization is going to focus on environmental issues, it will inevitably run into obstacles in economic problems.

The next factor included in the cause group is lack of resources. This lack of resources ranks 6<sup>th</sup> with an R-C value of 0.313. One of the main raw materials that support the circular economy principle is used products that are reprocessed. Public awareness of the lack of environment, makes them think that used products have no useful value. In addition, it was found that some suppliers do not approve the sale of used products, because they are worried about not being able to compete with new products.

The factor that ranks 7<sup>th</sup> is consumer awareness with an R-C value of 0.223. Most consumers rate that the new products have better quality compared to refurbished products. The next factor is lack of skill. The lack of skills ranked 8<sup>th</sup> in the cause group with an R-C score of 0.209. Most companies have workers with low skills and knowledge in implementing circular economy.

Effect Group is also referred to influenced factor. The quality of product is difficult to be maintained. This factor occupies a relation value (R-C) of -0.997 which ranks at 13<sup>th</sup>. Difficulty maintaining the quality of products is begun from reprocessed materials. It also requires a large cost for the production process when compared to managing products with new materials.

The next factor is profit and market demand. Profit and market demand factor has R-C relation value of -0.315 ranked at 9<sup>th</sup>. People usually does not concern about the environment especially furniture products. So, some organizations become hesitant to make the transition from linear economy to circular economy.

The next factor includes in the effect group factor is technological limitations. The factor has an R-C value of -0.689 with the rank of 12<sup>th</sup> as a hindering factor in the implementation of circular economy. The price spent on technology needs is very high. In addition, there is an additional workforce with good skills.

Perception factor about circular product ranks at 10<sup>th</sup> with R-C value -0.384. Consumers consider that refurbished products have a lower level of quality compared to new products. In addition, usually refurbish products have a lower price compared to new products.

The next factor included in the effect group factor is waste management. Waste management factor ranks at 11<sup>th</sup> with R-C value of -0.569. This factor is influenced by the company's inability to use all end-of-life products for remanufacturing or production bending or the inability to make outputs inputs for circular products. Design challenges are a factor that ranks at 15<sup>th</sup> with an R-C value of -1,138. This factor is influenced by lack of knowledge and skills from the R&D (research and development) to design circular products. In addition, the company also requires additional labor costs for experts in the field.

The last factor included in the effect group factor is return flows uncertainty based on R-C value of -0.991 this factor ranks at 14<sup>th</sup>. The recall program allows consumers to return their expired products. However, most of the products that have been sold will never be returned again. The condition also makes companies that may be doing the program worried about the uncertainty of the product returned to the company.

Furthermore, an Impact Relation Map (IRM) was formed that gave an idea of the relationship between one factor to another. Figure 2. represents the IRM for the overall.

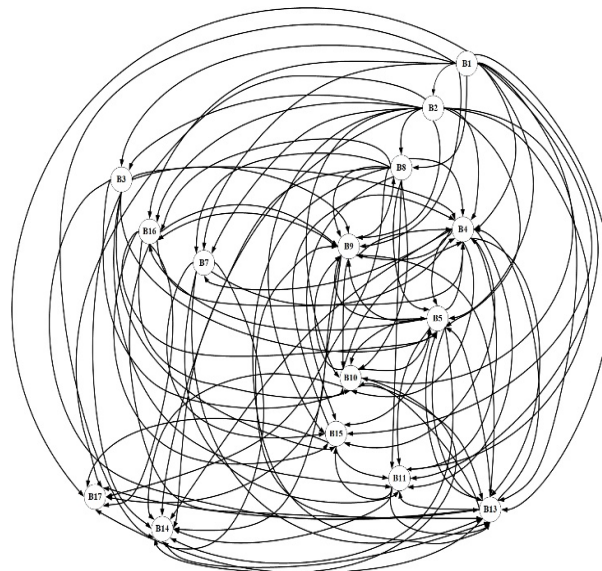


Figure 2. Impact Relation Map

To easier understand from Figure 2, then we make a description of the influence between factors which is carried out separately for each factor. Impact relation map each factor can be seen in Figure 3.

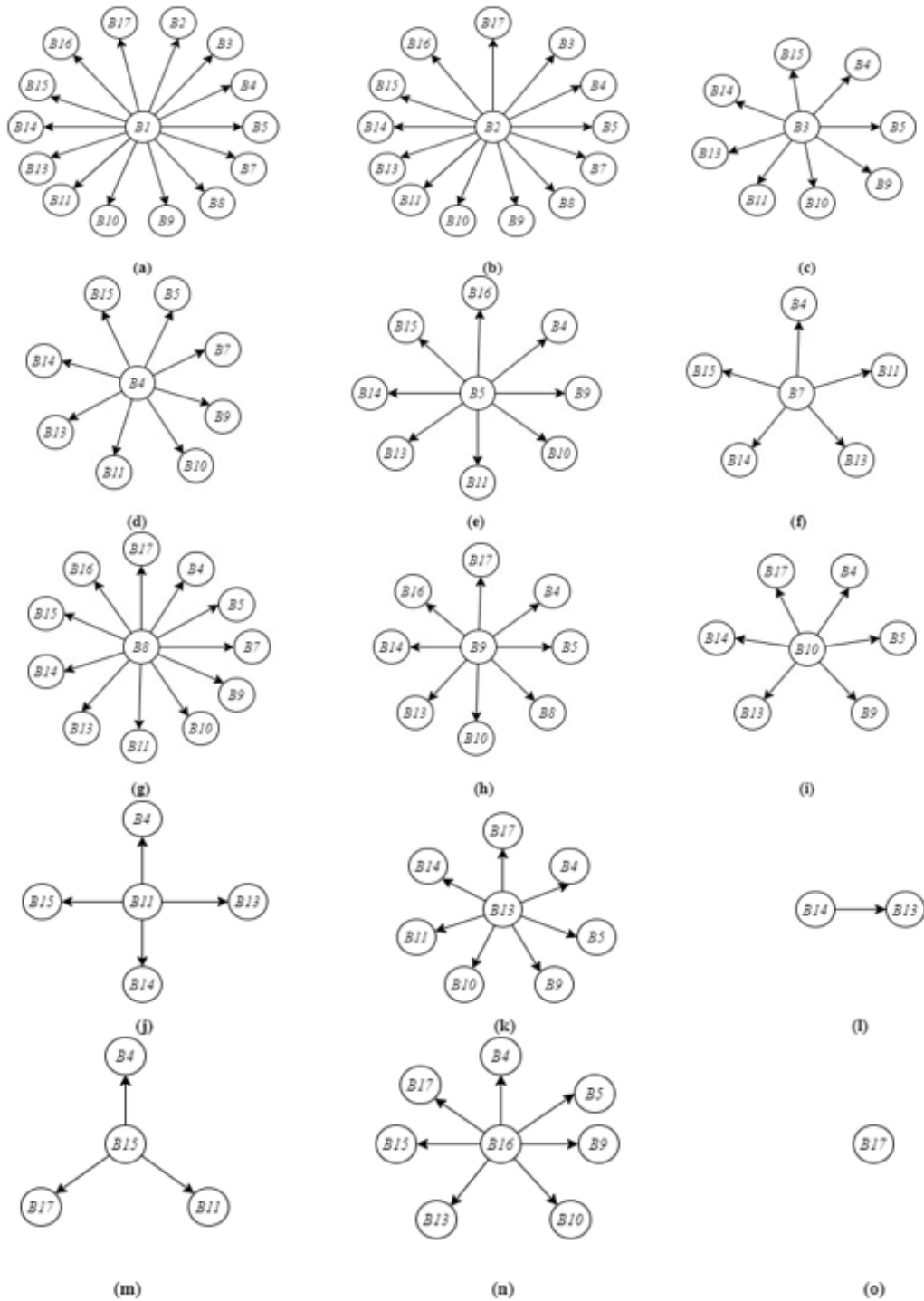


Figure 3. Impact Relation Map Each Factor

To better understand from Impact Relation Map in Figure 2, then we describe influence that dispatching to and receiving from each factor. This influence can be seen in Table 3.

Table 3. Dispatching to and Receiving from Each Factor



No	Barrier Factor	Code	Dispatching to	Total	Receiving from	Total
1	Government policies	B1	B2, B3, B4, B5, B7, B8, B9, B10, B11, B13, B14, B15, B16, B17	14	-	0
2	Poor of management commitment	B2	B3, B4, B5, B7, B8, B9, B10, B11, B13, B14, B15, B16, B17	13	B1	1
3	Lack of coordination and collaboration	B3	B4, B5, B9, B10, B11, B13, B14, B15	8	B1, B2	2
4	Economic/financial challenges	B4	B5, B7, B9, B10, B11, B13, B14, B15	8	B1, B2, B3, B5, B7, B8, B9, B10, B11, B13, B15, B16	13
5	Profit and market demand	B5	B4, B9, B10, B11, B13, B14, B15, B16	8	B1, B2, B3, B4, B8, B9, B10, B13, B16	9
6	Lack of skill	B7	B4, B11, B13, B14, B15	5	B1, B2, B4, B8	4
7	Lack of knowledge	B8	B4, B5, B7, B9, B10, B11, B13, B14, B15, B16, B17	11	B1, B2, B9	3
8	Consumer awareness	B9	B4, B5, B8, B10, B13, B14, B16, B17	8	B1, B2, B3, B4, B5, B8, B10, B13, B16	9
9	Perception about circular product	B10	B4, B5, B9, B13, B14, B17	6	B1, B2, B3, B4, B5, B8, B9, B13, B16	9
10	Technological limitations	B11	B4, B13, B14, B15	4	B1, B2, B3, B4, B5, B7, B8, B13, B15	9
11	Quality of product	B12	B4, B5, B9, B10, B11, B14, B17	7	B1, B2, B3, B4, B5, B7, B8, B9, B10, B11, B14, B16	12
12	Design challenges	B13	B13	1	B1, B2, B3, B4, B5, B7, B8, B9, B10, B11, B13	11
13	Waste management	B14	B4, B11, B17	3	B1, B2, B3, B4, B5, B7, B8, B11, B16	9
14	Lack of resource	B15	B4, B5, B9, B10, B13, B15, B17	7	B1, B2, B5, B8, B9	5
15	Return flows uncertainty	B16	-	0	B1, B2, B8, B9, B10, B13, B15, B16	8

Causal diagram depicted in figure 1. further divided into four quadrants to facilitate the understanding of the barrier factors the CE in the furniture industry. Quadrant is illustrated in Figure 4.

All of the factors that have passed the test validation is said to be a factor that is important or influential in the application of the circular economy, especially in the research is related as a limiting factor. To define the causal diagram became more clearly and helps in determining the recommendations of the strategy or priority improvement, these factors are grouped in 4 quadrant prominence-relation.

Quadrant 1 (core factors), factors in this quadrant have a high prominence value (R+C) with a high relation value (R-C). There are five factors that fall into quadrant 1, namely government policies (B1), poor of management commitment (B2), lack of knowledge (B8), economic/financial challenges (B4) and consumer awareness (B9). The factors that fall into this quadrant have a significant influence. The factor in this quadrant should be prioritized in the preparation of strategies.

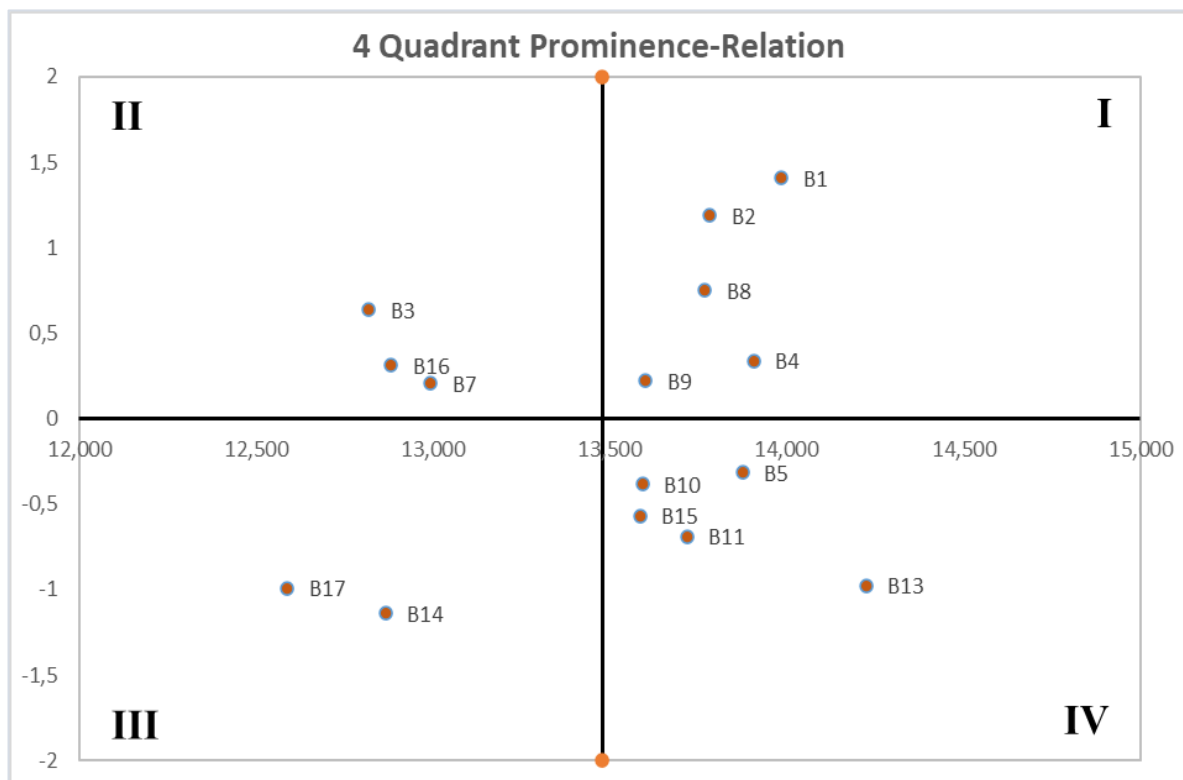


Figure 4. Four Quadrant Prominence-Relation

Quadrant 2 (driving factors), factors in this quadrant have a low prominence value (R+C) but have a high relation value (R-C). There are three factors that go into quadrant 2, namely lack of coordination and collaboration (B3), lack of resource (B16) and lack of skill (B7). This quadrant is the next quadrant to be considered for strategy preparation after quadrant 1.

Quadrant 3 (independent factors), factors in this quadrant have a low prominence value (R+C) and a low relation value (R-C). Factors belonging to this quadrant tend to have little interaction in the system. There are two factors included in this quadrant III, namely return flows uncertainty (B17) and design challenges (B14).

Quadrant 4 (impact factors), factors in this quadrant have a high prominence value (R+C), while the relation value (R-C) is low. Factors in this quadrant have a low level of relationship but have a significant impact on the overall system. There are five factors in this quadrant, namely profit and market demand (B5), perception about circular product (B10), waste management (B15), technological limitations (B11) and quality of product (B13).

#### 4.3 Proposed Strategies

Strategy recommendations are prioritized on barrier factors included in quadrants I and II, namely government policies (B1), poor of management commitment (B2), lack of knowledge (B8), economic/financial challenges (B4), consumer awareness (B9), lack of coordination and collaboration (B3), lack of resource (B16), and lack of skill (B7).

Strategy recommendations for government policies are carried out evenly through socialization, promotion and guidance to business actors engaged in the furniture industry. The government needs to enforce policies on manufactured waste and used products that are disposed of in land fill. The policy is in the form of providing high fees or tariffs to industry players. This is done with the aim of industrial players innovating to reuse waste. The existence of this policy not only has a positive impact on industry players but also increases consumer awareness of the environment. This policy has previously been implemented by the Australian Government and countries in the

European Union in controlling and changing the perceptions and habits of industry players and the public regarding waste (Daian and Ozarska 2009).

To improve poor of management commitment, companies need to build a circular economy business model by integrating circular economy thinking, which can be done with companies making the implementation of the circular economy a company vision with the goal of developing a national industry as well as an effort to develop a green industry. Top level management can motivate all elements of the company to always prioritize the circular economy principle to encourage reducing environmental impacts. Creating a group of internal company employees to explore and guide the change process (Szerakowski 2017).

The next strategic recommendation for economic/financial challenges is to increase economic empowerment. Recommendations for the government are reducing taxes on environmentally friendly activities, providing financial assistance and incentives to business actors who support a circular economy by providing easy access to credit for capital, restructuring of machinery or equipment. The restructuring program is given to SMEs by providing discounts on the purchase of machinery or equipment. Capital assistance can be carried out by fulfilling the requirements by business actors and linking these capital activities with other regulations and policies implemented by the government. The strategy recommendation for the factor of consumer awareness is to increase consumer awareness and participation in the implementation of the circular economy. Recommendations for business actors are to involve consumers to actively participate in providing feedback on products and providing different services to products with different warranty costs and warranty periods between new products and circular products so as to encourage increased consumer awareness. Business actors can initiate eco-labelling to attract customers' attention with the aim of increasing awareness of environmentally friendly products. Manufacturers need to make recycled products attractive enough to offset low quality prejudice associated with products made from used materials in order to compete with new products on the market (Singh and Ordonez 2016).

In lack of coordination and collaboration, the strategy is to increase support and cooperation networks. The recommendation for the government is to bring together business players in the furniture industry to open up opportunities for collaboration in the implementation of circular economy practices. This meeting can be held regularly to establish good communication between business actors so that they can help each other. The government facilitates the creation of an eco-industrial park. EIP (eco-industrial park) is able to physically connect producers which allows infrastructure sharing systems and trades waste products that may be waste from one company can be a source for other companies (Hartley et al. 2020).

Recommendations for business actors are to cooperate with suppliers to reuse them through 6R activities (reuse, reduce, recycle, remanufacturing, redesign furniture products that have expired into new products while maintaining quality to build a sustainable environmental management system in reducing impacts environment caused. Business actors can provide services to customers by reselling used products to companies such as buy-back services. This aims to help reduce the number of products thrown away. In addition, this buy-back program also makes it easier for producers to get used products. the availability is not always high. This program is also important to reduce the amount of waste that goes to the landfill (Bakker et al. 2014).

The recommended strategy for the government is to facilitate training or workshops in terms of design and technology. The government can intensify competition activities for furniture industry business players to improve skills. In Indonesia, there is one program called the Indonesia Furniture Design Award (IFDA). The program is a national level furniture design competition with the aim of creating the latest furniture designs that meet market tastes but still have Indonesian characteristics. Recommendations for business actors are to collaborate with experts or collaborate with global designers for design development and product innovation in increasing competitiveness.

## **5. Conclusion**

Factors that have been identified as barriers to the implementation of circular economy in the Furniture Industry of Central Java are government policies, poor of management commitment, lack of coordination and collaboration, economic/financial challenges, profit and market demand, lack of skill, lack of knowledge, consumer awareness, perception about circular product, technological limitations, quality of product, design challenges, waste management, lack of resource, return flows uncertainty.

Barriers grouped into cause group factors include government policies, poor of management commitment, lack of knowledge lack of coordination and collaboration, economic/financial challenges, consumer awareness, lack of resource, lack of skill. While the effect group factor consists of quality of product, design challenges, profit and market demand, perception about circular product, technological limitations, waste management, dan return flows uncertainty.

The strategy recommendations are aimed at the government and furniture industry businesses. The strategy is designed based on factors located in quadrant I and quadrant II in diagram 4 quadrant prominence-relation, namely increasing participation, support, responsibility and tightening regulations related to the application of circular economy, building circular economy business model, improving and promoting circular economy concept, network support and cooperation, improving economic empowerment, improving efficiency use of resource, building relationships and increase consumer attractiveness, and skills development.

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