



Toolkits for companies for evaluation of business from circular economy perspective

A Vietnamese Company as a case

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ABSTRACT

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Circular economy is one of the European Union's sustainable targets to replace the traditional linear "take-make-waste" economy model. However, some companies still have difficulty in understanding the circular economy concept and struggling to apply the principles of circular economy into their business. This results in slow transition from linear economy to circular economy. This thesis aims to boost the circular economy transition by designing toolkits for companies that can help them to exploit the opportunities of circular economy and implement its principles in their daily business. The toolkits were testified on a Vietnamese company as a case study in order to evaluate the effectiveness and advantages of the toolkit.

The research methods applied in this study were literature review and empirical research. The literature review method was used in the theory part of this thesis to explore the concepts of circular economy, its principles, applicable circular design, and business models, as well as circular opportunities and barriers. The toolkits were developed based on secondary data from a book by Perter Lacy, combining it with the knowledge of circular economy in theory part. An empirical study included the analysis of the testing result and the effectiveness of the toolkits on the case company.

In conclusion, the study found that the toolkits were applicable and practical for companies. The toolkits focused on embedding circularity into three important dimensions of a company: Operations, Products & Services, Culture & Organization. By utilizing the toolkit, the companies understood more about the principles of circular economy and were able to launch circular initiatives into their current business. Besides, the toolkits are suitable for a company in the early stage of circular transition or in developing countries where circular economy concept is still unfamiliar. However, the toolkits were rather simple and straightforward. This might decrease the effectiveness of the kits when being applied by mature companies. However, the toolkits can still be used as a checklist and an example of circular economy practices. More research is needed to improve the toolkits effectiveness such as adding more dimensions, in-depth analysis, and different industries.

Key words: circular economy, toolkits, company, development.

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1 INTRODUCTION

Circular economy model was recently introduced as one of the solutions to solve our waste production and material shortage problems in our modern world. It opened up a model that could support sustainability and focus on material restoration. Circular economy is a new business model that try to minimize waste and maximize effectiveness in production. With its high potential, circular economy has already been set as one of the implementations plans by the European Union. Correspondingly, many pioneer countries such as Germany, France and the Czech Republic have done and acted as great examples when it comes CE application (Hervey 2018). Finland has also created circular economy targets and roadmap which bring back opportunities for not only business but also society and environment. (Sitra 2016, 3) The circular economy concept is attracting more and more public interest and attention in developed countries; however, in many countries, this concept is still more like an idea than implementation.

Despite the popularity raise of circular economy, according to Platform for Accelerating the Circular Economy (PACE), the global circularity had fall from 9.1% to 8.6% from 2018 to 2020 (PACE 2020, 8). Many companies are struggled to implement circular economy principles into their business and move away from linear economy “take-make-waste” model. There are many challenges for companies to face in their circular economy journey, for example the lack of circular economy knowledge, inaccessible technologies, and resistance to changes (Kirchherr et al. 2017, 8). Therefore, a handbook that provides necessary toolkits and right understanding of circular economy concept is important for companies to make the transition.

This thesis aims to boost the circular economy transition by designing toolkits for companies that can help them to exploit the opportunities of circular economy and implement its principles in their daily business. The toolkits will be presented under the form of table and mind map. The toolkits were tested on a Vietnamese company as a case study in order to evaluate the effectiveness and advantages of the toolkit.

The main methods used in this research is literature review and empirical study. The theoretical part of thesis explains circular economy based on existing literature, explain the concept of circular economy, its principles, applicable circular design, and business models, as well as circular opportunities and barriers. The empirical part first introduces toolkits developed by applying “The Circular Economy Handbook: Realizing the Circular Advantage” by Lacy (2019) and then the target company VIJA Technology Company in Vietnam where toolkits were tested. Results of the testing and discussion about the usability of toolkit in development of business towards circular economy in the company is followed by concluding remarks.

2 THEORETICAL FRAMEWORK

2.1 From Linear to Circular Economy

The world is in the state where mass production is more preferred and linear economy is the dominant economic model (Lacy et al. 2019, 2). “Take – Make – Waste” is the basic concept of the linear economy. In linear economy, raw materials are extracted from the natural resources such as coal, oil, metal and created into products for human needs. These products can last from several minutes to almost a few years, then they are thrown back landfills or incinerators. Some example products represented linear economy are one-time-use plastic cups, plastic bags to non-renewable energy generation. This linear economic model focuses on low price, large quantity, and accessible material rather than high quality and sustainable production. Linear economy helped to produce more food and goods and generated economic growth (Sillanpää, Mika & Chaker 2019, 15). But it also led to various environmental, societal, and geopolitical problems.

Linear economy will leave behind a significant amount of waste, devastate environment, and will eventually affect the world economy (Weetman 2019). The consequences of linear economy and mass production are unavoidable. According to World Bank Group, in the year 2016, 242 million tonnes of plastic waste were produced, accounting for 12% of the total solid waste. As a result, marine animals are choked by plastics, ecosystem is destroyed, and microplastic can make their way up to human dishes (Environmental Science & Technology 2008).

Not only the environment, but economy will also slowly feel the negative effect from the traditional economy model. Natural resources are finite resources, and some industries that produce products from scarce materials will face the risk of shortage materials. For example, indium is used to create essential products such as touch screens, flatscreen TVs and solar panels, now it had been listed as critical material. If indium become deficient, industries such as computer and electronics industry, electrical equipment industry will face their downfall, and these sectors make up significant percentage of the economy (European Commission 2014)

The world will likely end up exhausting all the natural materials, leaving the environment with devastating consequences and piling up trashes on the way (Lacy et al. 2019, 2). If the economy keeps focusing on cheap quality and high quantity, products will soon be expensive and less due to the lack of material. The land will also be contaminated due to toxic waste from the landfill and health quality will decline. The linear economy is a dead-end, and we must find another sustainable solution for human next generation. This emphasizes the importance of the transition from linear economy to circular economy, a sustainable concept where we can fulfil human needs without destroying or exhausting all the natural resources.

2.2 Definition of Circular Economy

First of all, it is important to understand the meaning of CE concept. Ellen MacArthur Foundation (2012, 22) defined circular economy as “*an industrial system that restorative or regenerative by intention and design*”, and The Finnish Innovation Fund Sitra (2015, 4) stated that circular economy “*is based on the sustainable use of resources*”. In other word, circular economy is a waste-free economy which emphasizes on restoring, increasing the renewable energy, terminating the use of toxic chemicals, reducing the raw material input and waste production by thoughtful designs from the beginning stage of the product (Ellen MacArthur Foundation 2015, 22).

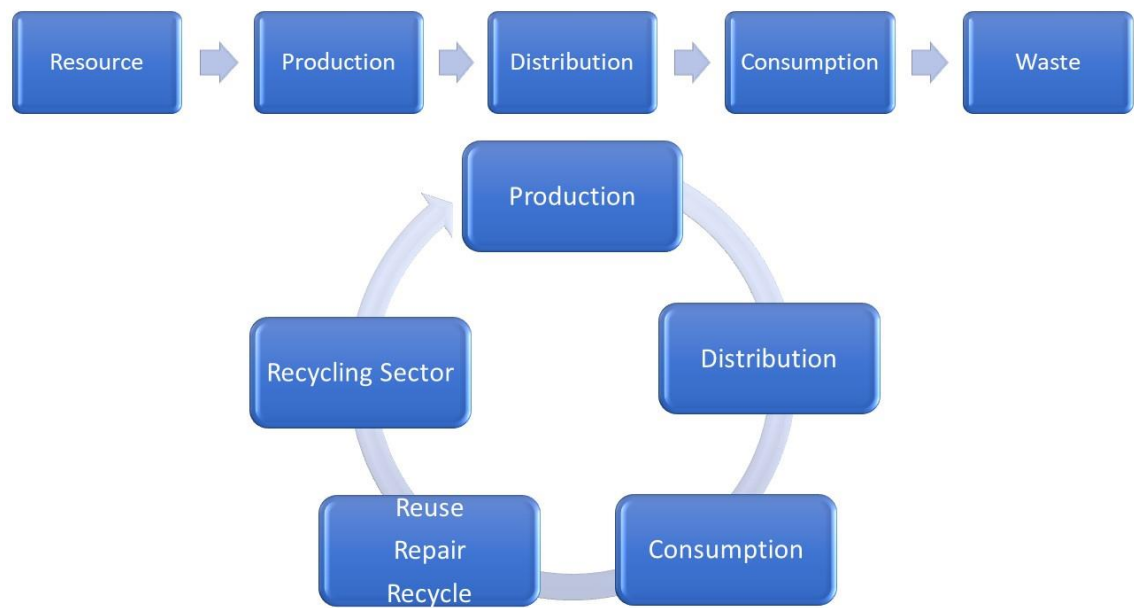


FIGURE 1. Linear Economy vs. Circular Economy

The difference between linear economy and circular economy is illustrated in Figure 1. Linear economy uses “Take-Make-Waste” process while circular economy uses “Take-Make-Recycle/Recover”. Linear economy is limited the initiatives to minimize the waste from production and consumption, whereas circular economy offers a more dynamic, resilient, and efficient structure that retains the value of materials within a closed loop, keeping materials inside production process (PBL Netherlands Environmental Assessment Agency).

2.3 Other Related Green Concepts

In order to understand circular economy, one also need to understand other related important green concepts. The concept of circular economy has been developed through many schools of thought: “Cradle-to-Cradle”, “Regenerative Design”, “Performance Economy”, “Industrial Ecology” and “Biomimicry” (Sillanpää, Mika & Chaker 2019, 14). However, there are two central concepts that have the most effect on the circular economy concept: “Cradle-to-Cradle” and “Performance Economy”. To get better understanding of circular economy, these two concepts will be explained in more detail.

2.3.1 Cradle-to-Cradle

"Cradle to Cradle" is a design philosophy where it focuses on the recycling and the material flow. The philosophy is about designing products so that it can be easy to reuse and recycle after used. When the product is in its "end of life" phase, it will remain value as resources for other processes (Braungart & McDonough 2002, 11). "Cradle to Cradle" design framework is based on three nature-derived principles:

- The waste of one production system can be "food" for another process. The principle states that "everything" can be designed, produced, used, and disassembled safely to "biological nutrients" though biodegradable in the soil or reintroduced to production cycle as "technical nutrients". "Biological nutrients" should not contain any toxic substance and should be easily biodegradable. "Nutrients" in the technical cycle such as polymers, alloys, or other human-made materials can be efficiently used or recycled with minimum energy and high outcome quality.
- Making clean and renewable energy as main energy sources in the production, decrease the need of fossil fuel while promoting human health and serving the environment.
- Taking nature as an inspiration by encouraging initiatives such as restoring and regenerating natural resources, creating opportunities for the growth of sustainable development. This principle is similar to the concept of Biomimicry which borrow nature's blueprints, recipes, processes, and ecosystem strategies and then comes up with design principles to solve problems (Benyus 2014).



FIGURE 2: Cradle to Cradle Design Concept

Taking the design of a shovel as an example of "Cradle to Cradle" (FIGURE 2). In its end of life, the handle of the shovel will be separated and generated into natural compost, becoming biological nutrients for plants, and eventually creating a new handle, this is called the biological cycle. In the technical cycle, the head of the shovel will be collected and recycled back to material for a newly made shovel. As a result, it will lead to the circular flow of material without any waste generation, this can achieve by well-thought design and responsible material selection.

2.3.2 Performance Economy

Performance Economy is another important concept that takes a significant part in shaping the circular economy model. Performance Economy is an economy concept, which business and consumers focus on the performance of the product rather than owning the physical form (Stahel 2019, 88). Taking the car industry as an example, one buyer now only buys the "use" or "performance" of the car, so when the car is no longer in use, it will be returned to the car manufacturer for recycling or repairing to be ready for next user. This concept leads the car manufacturer with two choices. One is to invest more in the design of the car so that

it can be easily recyclable and repairable with recovery material. Another alternative is to invest in the quality of the car, which means longer lifetime, better performance. In short, the performance economy focuses on four primary goals while designing the product: product-life extension, long-life goods, reconditioning and waste prevention. It also emphasizes on the importance of selling service instead of owning products (Sillanpää, Mika & Chaker 2019, 16)

2.4 Five principles of Circular Economy

Transforming to circular economy is a complex journey and in order to succeed, one must understand the principles of circular economy. According to Ellen MacArthur Foundation (2013, 22), there are five main principles for the circular economy: designing out of waste, building diverse systems, relying on energy from renewable sources, thinking in systems and treating waste as food or nutrient. These five principles ensure that the flows of materials and energy stay in the loop as long as possible, which in the long term will use little or nonvirgin material and maximize the value of nutrients from the cycle. Detail of the five principles is presented below:

Zero Waste Design: The first principle is based on the concept of “cradle to cradle”, products should be designed in advance so waste would be prevented by becoming “biological nutrients” or “technical nutrients”. The goal of this principle is to maximize the value of material in production. The “shove” in chapter 2 is a good example for this principle.

Resilience through Diversity: Modularity, versatility and adaptivity are the features that create resiliency. In the ideal situation, the same product type would have the same standard design so when it is broken or reaches its end-of-life, any functional part can still be used to replaced or remanufactured into another product. In the circular economy model, products should be a balance design between resilience and efficiency (Ellen MacArthur Foundation 2013, 22). For instance, Google had created a project called “Project Ara” that focus on design a mobile phone with modular design so it can be easily change its parts, accessories

(Bunton 2018). Customer could freely upgrade or repair the phone with parts instead of buying a new completed phone.

Renewable Energy: The core power of circular economy will be run by renewable energy. The use of non-renewable energy like coal, gas, or oil will be minimized and replaced by solar energy, wind energy, tidal energy, or other alternative renewable energy.

Systems Thinking: This principle focuses on the ability to understand how parts impact the others within a whole, and the relationship of the whole to the parts. In other word, looking at a big picture, considering the impact of all parts of circular economy rather than single elements in the system. After understanding how everything related to each other, innovation and choices can be made in order to ensure the highest efficiency to economic, social and environment. For example, in IKEA, after visiting showrooms, customers are guided into a warehouse where items are ready for purchase with extra choices of services such as delivery, restaurant. IKEA considers their customer's total experience in IKEA instead of focusing only on selling products.

Waste is Food: This principle is about shifting mindset from considering waste as no or little value material to the notion of a by-product. This means we should see biowaste as a biological nutrient that can be reintroduced or returned safely to the biosphere, while on the technical side, technical waste can be combined with other materials to create a high-quality product (upcycle) (Stahel 2019, 48).

2.5 Circular Product Design

Product design is the most critical stage of a successful circular economy business. The initial design determines 80% of the costs of product development, manufacturing, and use (Charter & Martin 2019, 24). A product design that takes environmental impact into consideration will have a better potential for the environmental benefit and cost reduction in future development (Pajunen 2015, 49). Products should be designed within a circular economy's mindset and principles

in order to be sustainable and well fit into the circular models (European Environment Agency 2017). According to a research (*Redesigning the Future*) conducted by the Royal Society for the Encouragement of Arts, Manufacturers and Commerce (RSA), there are four circular design models (RSA 2016):

1. *Design for Longevity*: This design model focuses on long life span and reliability of the products that can be dismantled for upgrade or repair by customer.
2. *Design for Leasing/Services*: The product is designed for rental, pay-per-use services. This model would focus on durability and repairability of the product to maximise efficiency and value in long term period.
3. *Design for Reuse in Manufacture*: This model aims to return end-of-life products or their parts back into manufacturer for an upgrade or parts replacement, so it can continue be resold (Zeb & Kortelainen 2021).
4. *Design for Material Recovery*: Materials and used products should be designed so it can be reprocessed and recycled into new materials for new products.

2.6 Five Circular Business Models

There are many circular models with different characteristic to choose, depending on their services and products. According to Accenture (2014), there are five main business models: Products as a service, renewability, sharing platforms, product-life extension and resource efficiency and recycling. Companies should follow one of these circular business models to maximize the value of product and resources. Depend on products and services, company can adapt these business model into their business.

Product as a service is an alternative solution to the traditional “buy and own” models. Products now can be used by one or many customers through a lease or pay-for-use arrangement rather than only one customer ownership. This encourages creating products with high durability and upgradeability, shifting focus from volume to performance. Product longevity, reusability, and sharing are no longer seen as cannibalization risks. It can be seen as drivers of revenues and

reduced costs in the product as service model (Sitra 2019). This model would benefit companies whose have high products cost and advantage in managing and maintenance products.

Renewability model is replacing the linear resource with fully renewable, recyclable, or biodegradable resource input that support circular production and consumption systems (Accenture, 2014). This model is the most potential for companies who have access to scarce commodities or deal with significant environmental footprint.

The Sharing Platforms business model promotes a platform for collaboration among product users, both for individuals and organizations. This model focuses on maximizing the potential usage of goods and resources through a digital platform for renting, sharing, reusing.

Product life extension model focus on extending the lifecycle of products and assets. This model offers services such as maintaining, repairing, upgrading, or exchanging parts to extend product usage. With product life extension model, product value is increased, and materials remain value. This help company to ensure their product will be more valuable for customer while creating new revenue steam for companies. This model is suitable for companies that serve markets where pre-owned products are common, or companies that provide goods or equipment to other business.

Resource recovery business model is based on the Cradle-to-Cradle concept and circular material. This model optimizes the value of material by reusing waste material and reintroduce it into process of making new product. Resource recovery model is suitable for companies that produce large amount of by-product or reusable waste material.

2.7 Business Opportunities in Circular Economy

Transition to circular economy is essential for nature environment and resource preservation, but the question remains: "Why circular economy is necessary for

business?” Circular economy is in its early stage of development and as a result, there are many opportunities for companies, business to exploit.

Circular economy offers new revenue stream for business. Eliminating waste and creating value for resources is one of the targets of circular economy. This creates demand for services such as waste recycling, resources recovery, and alternative sustainable solutions. Companies can take advantage of these increasing demand to create new business. For example, in the United Kingdom, a start-up company named Toast Ale was able to use waste bread to brew beer (Toast Ale). The company stated that they managed to save 42 tons of carbon emissions, more than 170,000 meter of land use and 250,000 liters of water. Another example is a famous tyres company called Michelin Solutions who created a successful business by using circular economy principals. The company moved from selling tyres to selling mileage to its heavy goods vehicle customers. Today, the billion-dollar Michelin Solutions business covers maintenance and additional services, such as route optimisation and fleet management (Groupe Michelin).

Circular economy offers companies to become more resilient and independent in supply sources management. The transition to circular path involves the usage of more remanufactured material and less virgin material. This helps companies reduce their exposure to volatile raw material prices and disrupted supply chains. As a result, companies would have a more stable, wealthy supply sources and a lower risk of bankruptcy (ING 2015).

Circular economy will also change customer way of thinking and create new demand for circular service. With circular economy system, services such as collection, delivery, dismantling, refurbishment of products will be increased in demand, which creates space for new profit stream and development. It also highly encourages services such as rental or leasing contracts, which can establish a longer-term relationship with customers. This would help companies gather insight from customer usage patterns and later used it for the improvement of product, better service, higher customer satisfaction (ING 2015).

2.8 Challenges of Circular Economy

The circular economy model sounds very promising and full of potential. However, the world is still in the early stage of building this economy model. Besides, there are still barriers and challenges that have not yet been answered. Circular economy transition's barriers can come from within companies and their suppliers, or from regulations and technology (FIGURE 4).

Cultural	Technological	Financial	Regulator
Company Culture	Circular Design	High upfront investment costs	Obstructing laws and regulations
Willingness to collaborate	Ability to deliver high quality remanufactured products	Limited Funding for circular projects	Limited Circular procurement
Consumer interest and awareness	Lack of data	Low virgin material prices	Lacking Global consensus
Operating in a linear system	Few large scale pilot projects		

FIGURE 4: Barriers of Circular Economy

Circular economy transition requires a lot of upfront investment. Business transformation might be costly, and not every business has enough budget or willing to make the investment without ensuring the success. Transition requires funds and upfront investment for infrastructure, research, and development project. Second problem is material prices. Some virgin materials are currently cheaper than recyclable, sustainable materials so that companies are discouraged to use them. For instance, fossil-fuel based plastics are much less expensive than the bio-based plastic (Kirchherr et al. 2017).

Companies are often resistant to change. Unsupportive corporation culture, lack of high-level commitment, and unwillingness to take risks are also reasons that companies do not want to transit to circular economy model. The existing business model may not be geared towards circular economy. Companies that used

to operate in linear economy will face more challenges when moving towards the new economy model as their partners and stakeholders may not be ready for circular economy. A firm can only deliver a circular product if its entire supply chain is circular. However, it is difficult for many firms to find companies that are also keen to embrace circular economy.

Although, government like EU focus on changing legislation to support circular economy, but they are still in the early process of implementation (European Commission 2019). Circular legislation is in development, although the process is slow and there are still holes needed to be filled. Furthermore, the current legislation still supports the traditional economy. The final barrier is the perceived lack of consumer demand for circularity products, which provide sustainability to the environment, which is usually more expensive than the traditional linear goods, which results in less demand and profit from those products (Kirchherr et al. 2017).

3 EMPIRICAL STUDY

3.1 Development of Circular Economy Toolkits for Company.

This chapter describes the development of three toolkits that help companies to find opportunities to apply circular economy principles into their business. The three toolkits focus on three different fundamental circularity dimensions in a company: operations, product & services, culture & organization. Each of dimension will have a separate toolkit that contain smaller focus areas (Figure 5) These three toolkits can be used to evaluate company's circular journey and to practiced circular economy's initiatives. The toolkits are developed based on an important source of information "The Circular Economy Handbook: Realizing the Circular Advantage" by Lacy (2019). During the stage identifying circular opportunities, many factors should be considered such as industrial characteristic, product and services, strength, and weakness of the company. By using the toolkits, companies can identify what circular opportunities are available and suitable for them to pursuit or improve.

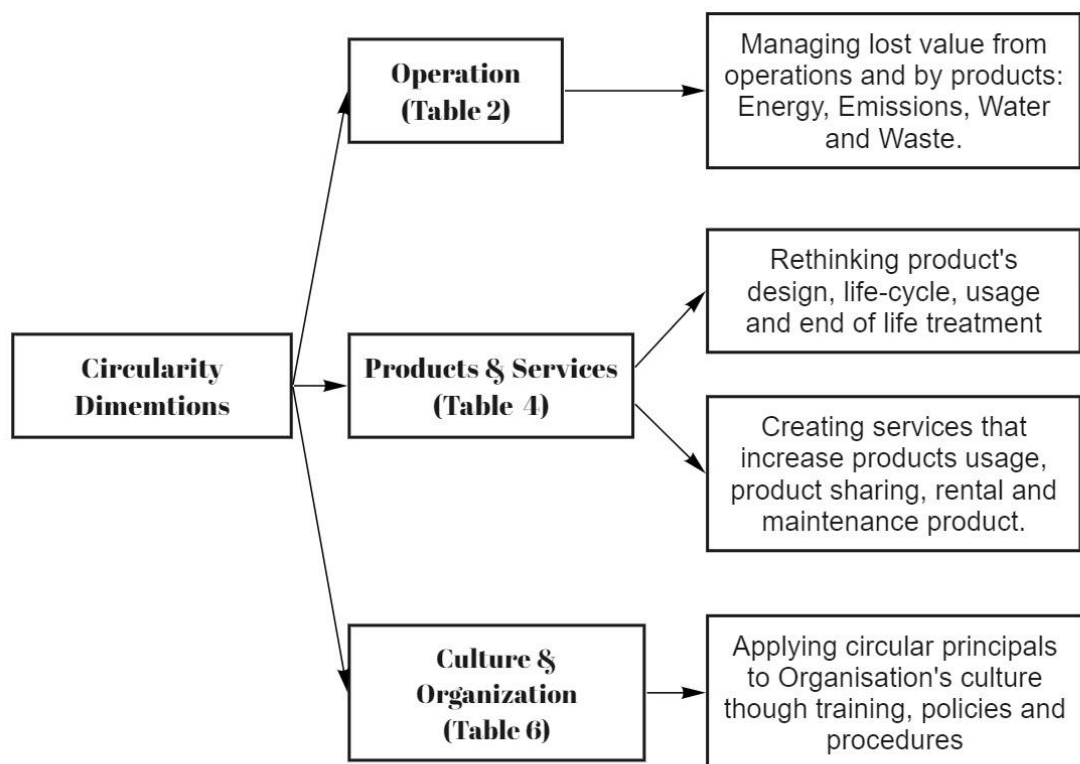


FIGURE 5. Three Circularity Dimensions

These dimensions (Operation, products & services, culture & organization) are closely connected and support each other (Lacy et al. 2019, 205). These three dimensions are often considered as their first and crucial step in their circular economy journey, because these are more manageable and controllable (Lacy et al. 2019, 284). However, depending on company's industrial, competitiveness and customer demand, companies can choose to focus on one of these dimensions.

The toolkits provide a recommended circular initiatives and actions in each dimension (Table 2, Table 4, and Table 6). The toolkits are also visualized and simplified by the form of mind map for readability and overall view (Appendix 1, Appendix 2 and Appendix 3).

3.1.1 Dimension: Operation

According to Lacy (2019, 215), there are four areas that companies could focus their circular initiatives in operation: Energy, Emissions, Water and Waste (See Table 1).

In the beginning of circular journey, companies often look at operations dimension to start their circular economy efforts. Operation in a company is defined as managing the inner working of the business to maximize the efficiency in the process (Kiisel n.d). So when a company implements circular economy into their operation, it means using circular economy principles into to their business production such as using recycle material, renewable energy, or waste sorting. The goal of implementing circular principles in operation is to increase effectiveness while reducing environmental impact.

TABLE 1. Focus Areas – Operation (Lacy et al. 2019, 216)

Operation	
Areas	Target

Energy	Pinpoint and implement measurement that reduce energy consumption, increase energy efficiency, shift from fossil fuels to renewable sources.
Emissions	Identify emission points in the operations core and value chain, make suitable interventions to reduce those emissions.
Water	Reduce water dependence by minimizing water abstraction, periodizing water saving opportunities and increasing water reuse.
Waste	Aim for zero waste by reducing or eliminating waste leakage, reduce waste capacity by maximizing asset utilization.

Circular operational initiatives are often straightforward to carry on, short-term pay-back, and existent in company's boundary (Lacy 2019, 216). Simple Initiatives such as cutting down energy, reducing and collecting waste for recycle can be identified as "quick wins" and become foundation for more in depth and long-term pay-back initiatives. In the long run, organizations should take circularity to next level by using renewable sources instead of raw materials and energy, re-using waste, or converting waste into useful by-product. Table 2 illustrated opportunities for company to apply circular principles in Operation dimensions.

TABLE 2. Circular Opportunities Toolkits: Operation.

OPERATION			
Focus Areas	Addressing Questions	Preferred Answers	Example Initiatives
Waste	Is waste monitored how much waste is produced?	Yes	Measure and monitor to identify where in the value chain need improvement. Classify the type of waste generated.
	Is waste tradable/re-cyclable or reusable?	Yes	Make cooperation with companies that use the waste. Non-recyclable waste to energy.

	Are there instruction on how to handle the waste?	Yes	Formulate clear instructions about sorting and disposing each type of waste.
Water	Is it monitored how much water is spent?	Yes	Measure and monitor to identify where in the value chain need improvement.
	Is water used nature resources?	Yes	Identify opportunities to use nature water as the main sources.
	Is water consumption efficient?	Yes	Check water leakage frequently. Reuse wastewater in other process.
	Is it returnable to nature in a sustainable way?	Yes	Use technologies to eliminate negative impact of the water before releasing.
Energy	Is it monitored how much energy is used?	Yes	Measure and monitor to identify where in the value chain need improvement.
	Is powered by renewable energy?	Yes	Change to renewable energy as main energy source.
	Is energy system such as lighting, heating/cooling of the building optimize?	Yes	Use energy saving system for offices or any building.
Emission	Is it monitored how much emission is produced?	Yes	Measure and monitor to identify where in the value chain need improvement.
	Does logistic have optimize route?	Yes	Optimize logistic route for less carbon footprint.
	Does the company release any toxic chemical, substance into the environment?	No	Remove any hazardous substance from the process. Replace toxic substance from products with environmentally friendly materials.

Table 2 provides companies with a broad view of opportunities for the development of circularity. The toolkits may also help company to pinpoint most leakage in energy consumption, carbon emission, water usage or waste management in their operation. These leakages will create opportunities for circular implementation. Particularly, in waste area, company should ask “Is their waste tradable/recyclable or reusable?”, if the answer is yes, this criterion is approved; otherwise, they should look at example initiatives column in the table. However, to turn these opportunities into reality, companies must get creative in thinking about new ways to eliminate or reuse waste selling waste streams to parallel industries, renting out their excessive production, storage or logistic. Appendix 1 is a mind map that have been simplify from table 2 for more visualization.

3.1.2 Dimension: Products & Services

Achieving sustainable circular products and services is a challenge and complex target, companies can break it down into four manageable stage to focus on: Design, Use, Use Extension and End of Use (TABLE 3).

Products and services have large impacted on how the customers and investor’s view companies and business. By providing sustainable products or services, companies can greatly improve their image and their reputation with customer, attract more talents and increase customer loyalty (Lacy et al. 2019, 233). To bring circularity into a company’s portfolio, their products should be designed with circular mindset (See Chapter 3.2) and their services should follow one of the five economy business model (See Chapter 3.3).

TABLE 3. Focus Areas – Culture & Organization (Lacy et al. 2019, 234)

Culture & Organization	
Areas	Target
Design	Redesign products so it uses less resources, single-use materials, and better durability. Enable repurposing product for second value beyond first usage.
Use	Increase value delivered by using Product as Service to maximize product utilization.

Use Extension	Extend the use of product through Product Use Extension business model such as maintenance, repair service.
End of Use	Identify circular use for waste and upcycling at the products end of life.

All four of these factors are closely connected and companies should try to go through all these stages when designing products. Although, for efficient investing, companies can use Table 4 to single out initiatives that have the most potential and suitable to their business. For example, Kitchen appliances company can decide whether to focus on redesign their products in a circular manner or to create new circular services such as reverse logistic, maintaining or upgrading. Depend on company's industrial characteristic, maturity, and other factors (market trends, customer readiness, available technologies...) should also be considered when selecting initiatives. Appendix 2 is the mind map of Product & Services and TABLE 4 is the check list of Product & Services.

TABLE 4. Circular Opportunities Toolkits: Products & Services

Products & Services			
Areas	Addressing Questions	Preferred Answers	Example Initiatives
Design	Is the product use recycled, sustainable materials?	Yes	Reduce the use of raw materials in the products and replace it with recycled sustainable materials.
	Is the product design for long lasting value (Upgradable, Durable or Reusable)?	Yes	Company can follow circular product design principles to make the product more circular. (Chapter 3.1)

Usage	Can the product be shared?	Yes	Increase utilization by sharing and reusing the product. Offer/change to performance model. Design the product to be upgradable and maintainable. Implementing circular business model. (Chapter 2.7)
	Can it be bought or sold as services?	Yes	Use performance business model for leasing or pay-per-use model.
	Is the product durable?	Yes	Reverse logistic to collect and repair used product for second-hand market.
Extension	Is the product easy to repair?	Yes	Company can offer maintenance services or offer self-repair package as another services.
	Can parts of the product be re-used?	Yes	Reverse logistic to collect and sell used parts for second-hand market. (Example: auto parts)
	Is possible to upgrade parts?	Yes	Product should be design in modular concept for easy exchange and upgrade.
End-of-Life	Does the product have end of life treatment?	Yes	End of life treatment should be designed when designing the product. Use recyclable materials for the product.
	Is there a product's disposal guide for customers?	Yes	Create disposal handbook for customer to maximize the value of product. (taking out parts, recycle, resell part...)

	Does the product have life cycle assessment?	Yes	Products should have life-cycle assessment for the best understanding of its impact on the environment.
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3.1.3 Dimension: Culture & Organization

To embed circularity into a organization core, leaders should consider focusing on three areas: Vision, Innovation, and People. (TABLE 5). Transition to circular economy requires companies to have a strong core of circularity. Companies can strengthen its core by applying circular principles into company's vision and corporate mission. Companies can also give out the right organizational incentives such as encouraging for circularity innovating, implementing circular operations, circular product, and services. It is important that company's culture is heading the right way because it plays a vital part of the transition to circular economy.

TABLE 5. Circular Economy Transition: Culture & Organization (Lacy et al. 2019, 260)

Culture & Organization	
Areas	Target
Vision	Set a long-term goal for the organization's circular journey with milestones and supporting target. Develop mission, objective to assist circular vision and gather resources for business to implement circular initiatives.
Innovation	Encourage innovation across the organization. Set up a "laboratory" mindset toward innovative circular thinking. Share knowledge, conduct learning, invest in research and development about circular design, material, and business model.
People	Increase employee's involvement in circular activity in the organization such as circular project sponsored, provide circularity training, benefits when apply sustainable lifestyle.

A study from Accenture (Barea & Silverstone 2016) had showed that for an organization to fully adapt with new cultural value, employees in all level need to participate and be involved in the change. It is the same with circular economy, not only executives but also employees need to feel and practice circular principles into their daily work. Organizational change is not an easy task, and the bigger the company size, the harder it will get. Circularity in a company's culture should not be feel like "extracurricular", it should be familiar and comfort for the company. Circularity should be planted into employee's tasks and functions in their roles. Promoting awareness across the company sector and remove tension from those who might be resistant to the chance. Companies can use Table 6 to identify circular initiatives that can be used to embed circularity into the company's culture.

TABLE 6. Circular Opportunities Toolkits: Culture & Organization

Culture & Organization			
Areas	Addressing Questions	Preferred Answers	Example Initiatives
Vision	Does company have a long-term goal in their circular journey?	Yes	Create a clear goal with milestone based on company's strength, situation, and opportunities. Integrate circularity into the existing business principles.
	Does company have a concrete strategy to achieve these goals?	Yes	Define circular opportunities, characteristic of industrial and customer interest to create suitable strategy.
	Does company have influence on their partner, stakeholders?	Yes	Increase influence by cooperation, partnership, and project.

	Is company circular vision being shared?	Yes	Share circular vision with customer, employees, and stakeholder through advertisement, company policy and leadership.
Innovation	Does company enable “laboratory” environment?	Yes	Create learning environment by brainstorming section, suggestion box and sharing knowledge between employees.
	Does company encourage employees to learn and share knowledge about sustainability?	Yes	By providing training, lesson to employees to increase employee’s knowledge. Set up learning project for employees in company.
	Does company have “light-house” project?	Yes	Create leading project to show case potential of circular economy and its benefits to internal employees and to stakeholder.
People	Does company promote their circular target to its customer?	Yes	Advertise company’s circular target to its customer, provide circular product and services to its customer.
	Does company’s policy support circular transition?	Yes	Circular accountability is introduced and rewarded. Non-financial incentives and encouragement for adopting circular behaviours.
	Does company partner with other stakeholder to exploit circular opportunities?	Yes	Set up partnership with recycle partner for office waste (paper, carton...).

3.2 Testing the Toolkits in case company

VIJA Technology is one of the first companies in Vietnam that specialize in research, production, and distribution of self-efficiency signalling lanterns that use power solar energy. These lanterns are designed to use as aviation obstruction lights, marine lights, and inland waterway signals. VIJA Technology company is a small-scale business, with less than fifteen employees and annual revenue around 100 000 USD. According to Mr. Nguyen, CEO of VIJA Technology, despite being a small business, VIJA Technology is one of the most trusted distributors of marine lights in Vietnam, their products are used widely in all over the country. Due to high quality products and services, Vietnam Government has trusted VIJA Technology as one of their primary business partners and provide around 80% of the company total profit. Not only in Vietnam, but VIJA Technology has also managed to export their products to foreign countries such as Netherland, Italy, Greece, Turkey, Egypt, India, Lebanon, Singapore, Malaysia, Indonesia, Philippines.

One of VIJA Technology's most signature products is their self-design high quality solar powered signal lanterns, which has been trademarked as VIJALight ® (PICTURE 1). VIJA Light ® can be used for many purposes like aviation warning devices or inland waterway signal, but they are professionally designed for marine navigation lights for sea-going steam vessels. (VIJA Technology, 2019)



PICTURE 1: VIJA Light ® Product – VIJA 218 (Source: VIJA Technology 2020)

VIJA Technology is a manufacturing company, and their business model is simple: designing product, ordering components made from third parties, assembling products, and selling products to the customer. FIGURE 6 shows VIJA Technology current business model. Their products have two years warranty, VIJA Technology's services include instalment and transportation for their customer. The company does not have any take back services for proper disposals, broken products usually end in land fill or scrap for recycle parts.

VIJA Technology Business Model

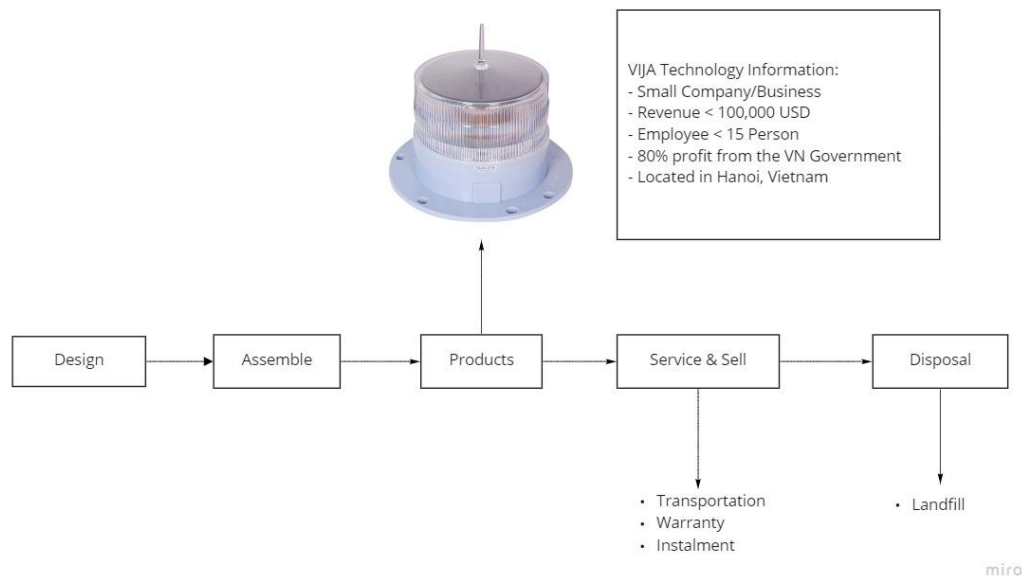


FIGURE 6 VIJA Technology Business Model

VIJA Technology is a suitable case company for testing the toolkits due to its size and location. As a small size company, VIJA Technology can quickly adapt to changes, leaders will have considerable influences on employees and working cultures environment. With these advantages, the toolkits will be able to test on all dimension of the case company. VIJA Technology is located in Vietnam where circular economy concept is fairly new. Circular economy concept was introduced in Vietnam in the late 2020 by the Vietnamese Government (Luong 2020). As a result, Vietnam's businesses are paying more attention to sustainable developing and circular economy model, however they are lacking the necessary knowledge. By using the toolkits in VIJA Technology, the study can learn more about toolkits' effectiveness for companies in developing country.

In the beginning of the testing process, the author provide company with basic understanding of circular economy concept and its application. After the company had the necessary knowledge of circular economy, the toolkits were sent to VIJA Technology and asked to be filled in. After toolkits were filled, the author start analyses the result. In order to gather more insight and data for the analyses, the

author composed a list of question regarding the toolkit's application. Conversation between the authors and VIJA technology's employee was conducted by many methods including emails exchange, interviews, and face-to-face discussions.

4 RESULT

4.1 Dimension Operation

Because VIJA Technology orders parts from third party for their products, the company does not use intensive resources in their operation. VIJA Technology's main operation is assembling products and testing to make sure the product's quality is reached. This process requires human labour rather than natural resources, this result in low waste and emission production. Emission produced mainly come from logistic due to delivery services in the country. The company produces small amount of waste during assembling process and other normal office waste such as paper, carton, plastic warps. However, VIJA Technology can still apply circular opportunities to reduce environmental impact and increase efficiency in their operation. TABLE 7 shows how the toolkits is used by VIJA Technology.

TABLE 7: Toolkits Used in VIJA Technology's Operation

VIJA Technology's Operation			
Focus Areas	Addressing Questions	Answers	Additional Information
Waste	Is waste monitored how much waste is produced?	No	Waste is not monitored because VIJA Technology does not produce much waste. Although, there are small amount of waste office and broken products/components.
	Is waste tradable/recyclable or reusable?	Maybe	Office waste (paper, carton, aluminium) can be recycled. Plastic, circuit board, solar panel other product components cannot be recycled due to lack of recycle technology and factory in Vietnam.

	Are there instruction on how to handle the waste?	No	End-of-life products end in land-fill.
Water	Is it monitored how much water is spent?	No	Water usage is not monitored due to little use.
	Is water used nature resources?	No	
	Is water consumption efficient?	No	
	Is it returnable to nature in a sustainable way?	Yes	Company use water is for testing products water resistant. No chemical is added into water. This water is later use for watering plant and garden.
Energy	Is it monitored how much energy is used?	Yes	The company monitor energy usage though electricity bill. Company does not use energy intensive in their operation.
	Is powered by renewable energy?	No	
	Is energy system such as lighting, heating/cooling of the building optimize?	No	
Emission	Is it monitored how much emission is produced?	No	
	Does logistic have optimize route?	No	
	Does the company release any toxic chemical, substance into the environment?	No	VIJA Light ® has certificate for safety and quality product in Vietnam.

The result of the operation toolkit used in VIJA Technology indicate that the company has small impact on the environmental although, the company is lacking sustainable practices in their operation. Across four focus areas (waste, water, energy, emission), the company feel no need for immediately change in their operation due to low resources usage and waste production. However, to further reduce environmental impact and migrate risk, VIJA Technology should add monitoring application in resource usage and waste production for better analysis and optimization. When choosing partners for logistic or component parts, the company should also consider sustainable factor such as material use, local partners.

After using the toolkits and analysing the data, VIJA Technology realizes that energy area is the most impactful area among four focus (waste, water, energy, emission) in operation dimension. Energy is the most use resources in the company's operation and it makes sense for the company to apply circular initiatives to increase energy efficiency and reduce carbon footprint. Improving energy efficiency will positively impact on the company because it can reduce cost while making company become more sustainable. For example, VIJA Technology can change to self-provide renewable energy such as solar energy. Solar energy is a valid option for the company because it is located in Hanoi, Vietnam, a country that has strong sunlight years round. It has been estimated that installing solar panel in Vietnam can repay itself after 8 – 10 years, after that the solar panel will produce profits in the next ten years until it reaches its end of life (Northern Power Corporation, 2017). Besides, using energy-saving light bulbs, A rating efficient appliances would help to decrease total energy use in office.

VIJA Technology should also pay attention to the three other focus areas (waste, water, emission) in order to grow evenly. Circular initiatives such as monitoring waste and water use are necessary to identify future circular opportunities and optimization. Sorting recyclable waste and selling to waste collectors can help company cut cost. Company can also reduce carbon footprints by optimise logistic when deliver to customer, using more sustainable packaging, creating a proper end-of-life disposal guidelines for the customer.

4.2 Dimension Products & Services

VIJA Light ® is the signature product of VIJA Technology, and it was designed with long-lasting, durability, and highly efficiency in mind. VIJA Lights ® have six main components: body case, lens, rubber seals, electrical circuit, battery, and solar panel. TABLE 8 show the detail and analysis of each material used in VIJA Light's ® components. These components were designed by VIJA Technology and was ordered to made by third party manufacturers (VIJA Technology, 2019). Materials used in VIJA Light ® are common and it does not require any specific raw material. Some of the materials (silicone, solar panel, PCB, and LiFePO₄ battery) are hard to recycle, they require advanced technology or a professional recycling third party that Vietnam does not have at the current state. VIJA Light ® is designed so that the product would require minimum of maintenance and can operate in a hard environment.

TABLE 8. VIJA Light's ® Material Use

Parts	Material	Recyclable	Material Information
Body Case	Plastic ABS	Yes	Acrylonitrile Butadiene Styrene (ABS) is a thermoplastic that can be found common object such as keyboard, power-tool housing, 3D printing and LEGO toys. ABS plastic is safe and there are no known adverse health effects related to expose to ABS. ABS plastic is 100% recyclable. (Rogers, 2015).
Lens	Plastic PC	Yes	Similar to ABS, PC plastic is also thermoplastic that used for sunglass, electrical hardware, construction material. PC plastic can be fully recycled. (Rogers, 2015).
Rubber Seals	Silicon	Yes	Silicon is commonly used for food containers, and car industry for its strong resistance to heat and impact. Silicon is recyclable although, it has to be sent to specialized recycling company for proper recycle and down

			cycle. Therefore, silicon is usually end up in landfill and hardly degradable.
Electric Circuit	FR4	Yes	FR4 is durable, has excellent resistance and high efficiency, although recycling FR4 PCB is a challenge due to its complex material used., PCB would usually end up in landfills or export to other countries like India or China for recycling. (Automation, 2019)
Battery	LiFePO ₄	Yes	LiFePO ₄ is known for its steady chemistry, high performance, suitable for self-recharging, non-toxic, and safe to use LiFePO ₄ is recyclable in theory, although the process of recycling Lithium-ion battery is still expensive and may not be economical. (Wang et al. 2019)
Silicon based Solar Panel	mono-crystal-line	Yes	Solar Panel can last up to 30 years before decommissioning. Solar panel can be recycled up to 96% although, technology that require to reach this efficiency is still limited to some country. (Vekony 2021)

After applied circular toolkits in VIJA Technology's products & services dimensions, the company realize some advantage of their product as well as their potential in new circular business. It is cleared that that durability and long lasting is the main design concept of VIJA Light ® and the company can transfer to circular business model by using this advantage. Instead of selling products, company can offer rental services with maintenance, repair and replace services. This circular business model has great potential, and it could be the next target for VIJA Technology to acquire. VIJA Light ® is lacking end of life treatment. When the products reach its end of life, it usually ends up in landfill without any further treatment.

By using the toolkits in Products & Services dimension, VIJA Technology can apply circular initiatives in order to improve their product so it can be more sustainable and recyclable. First, the company can use recycle material in their product. VIJA Technology does not actually produce any component themselves but imports from third party companies. This can be used as an advantage because the company can have a wider range of choices for materials and suppliers. For example, VIJA Technology can choose to use recycled plastic and recycled battery. Second, VIJA Technology can improve their product design by adding onsite repairing factors into the product. Because VIJA Light ® is usually installed on water lane or in a harsh environment, the product should be repairable without sending it back to manufacturers. This helps the products extend its usage and remain value for a longer period. By using circular guidelines, VIJA Technology can consider other circular design strategies such as online monitoring, module design, reusing and upgrading.

There are other circular initiatives that VIJA Technology could apply in their Products & Services dimension. For instance, importing parts from local suppliers instead of foreign suppliers can decrease carbon footprints in logistics for the company. Creating a collaboration between suppliers and the company for a better recycling rate and take back. The company should also assess their product life cycle to understand how their products impact the society and environment while tracking their circular process at the same time.

TABLE 9. Toolkits Used in VIJA Technology's Products & Services

Products & Services			
Areas	Addressing Questions	Answers	Additional Information
Design	Is the product use recycle, sustainable materials?	No	In VIJA Technology respective, recycled material is more expensive may not meet the requirements for the product.

	Is the product design for long lasting value (Upgradable, Durable or Reusable)?	Yes	VIJA Light ®'s design focus on durable and efficient.
Usage	Can the product be shared?	No	
	Can it be bought or sold as services?	Yes	VIJA Light ® used in water way as traffic signal so the product is needed to be function at all times. This poses a need for services such as maintenance, replacement, and leasing.
	Is the product durable?	Yes	VIJA Light's ® design focus on durable and efficient.
Extension	Is the product easy to repair?	No	VIJA Light ® products have to be water resistant so it must be tight seal which result in difficult to repair.
	Can parts of the product be reuse?	Yes	If some parts are useable, it can be reinstalling in new product
	Is possible to upgrade parts?	No	
End-of-Life	Does the product have end of life treatment?	No	
	Is there a product's disposal guide for customers?	No	

	Does the product have life cycle assessment?	No	
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4.3 Business Model

Although VIJA Technology business model is a linear economy which focus on profit and selling quantity, the company can transfer to a more circular business model. VIJA Light ® are typically used in open environments, this requires VIJA Light ® to be durable, resistant to the harshness of the environment while still providing efficiency performance. This means that the products should always be in good condition and frequently maintenance or replace when malfunction. Taking these factors into consideration, VIJA Technology company could utilize the following circular business model: Products as a Service. “Product as a service” is a business model that replaces the product's typical ownerships with service through contracts, leased, or agreement between parties (Accenture, 2014). This circular economy business models show great potential which the company could exploit, but also full of difficulty and challenges to face.

In this model, VIJA Technology would sell the product's performance combining with repair and maintenance services instead of physical ownership. If the product meets its end of life, VIJA Technology will replace and collect the malfunction product to repair, reuse, or recycle. This process would benefit VIJA Technology in terms of materials, components and secure their supply risk. In case of products are no longer meet customer's demand, VIJA Technology would offer alternative solutions such as exchange or upgrade. This will benefit the client as their need for performance product will always be fulfilled and can be flexible over time. FIGURE 7 illustrated VIJA Technology's application of circular economy by applying “product as a service” model.

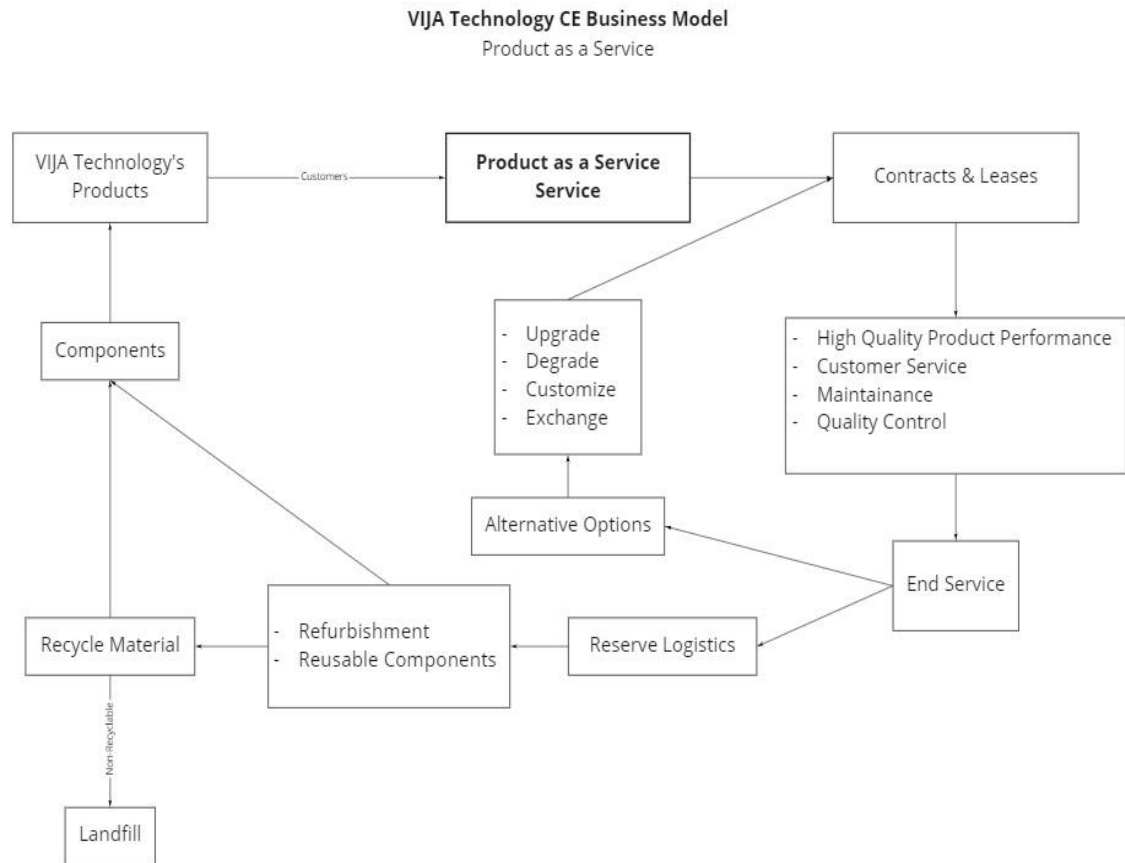


FIGURE 7: VIJA Technology – Product as a Service Model

Although, there are some challenges that prevent VIJA Technology from utilizing the “product as a service” model to its fullest potential. The first challenge is from their main customer - Vietnamese Government. Due to the complexity of legislation, it is difficult for the government to go through rental, leasing contract with businesses. Instead, they prefer to buy off the product as usual. The second challenge is the upfront investment the company has to pay. This model is a long-term investment; in the first phase of implementing, the company’s income might shift downward, affecting the business operation.

4.4 Dimension Culture & Organization

VIJA Technology is in the beginning of understanding circular economy concept, the company have not applied any circular principles into their company (Interview). As a result, when the toolkits were applied in Culture & Organizational dimensions, it shows that the company is lacking awareness about circularity and sustainable development. (TABLE 10). This is understandable because Vietnam is a developing country where companies often focus on profits and selling rather than the environment. However, VIJA Technology start to realize the important of adaptation to circular economy. By using the circular toolkits in Culture & Organizational dimensions, VIJA Technology will be able to see what they are missing and how to improve upon.

TABLE 10. Toolkits Used in VIJA Technology's Culture & Organization

Culture & Organization			
Areas	Addressing Questions	Preferred Answers	Additional Information
Vision	Does company have a long-term goal in their circular journey?	No	
	Does company have a concrete strategy to achieve these goals?	No	
	Does company have influence on their partner, stakeholders?	Yes	The company can directly influence how their product components made such as material, design... Their main partner is Vietnamese Government which is very hard to have influence on.

	Is company circular vision being shared?	No	.
Innovation	Does company enable “laboratory” environment?	No	.
	Does company encourage employees to learn and share knowledge about sustainability?	No	
	Does company have “light-house” project?	No	
People	Does company promote their circular target to its customer?	Yes	
	Does company’s policy support circular transition?	No	
	Does company partner with other stakeholder to exploit circular opportunities?	No	

It is important for an organization to have a shared vision and targets for their circular journey. A shared vision can help company set up road map including milestone, suitable strategies, and important partner for their transformation. After having a shared goal, company can encourage circular activities with financial reward or benefits. Environmental awareness should be spread across the whole company, from employers to every employee throughout meetings, lecture, or

even volunteer work outside the office. Employers should also create opportunities for their employees to practise sustainable lifestyles such as encouraging the use of public transport, car share or even walk or cycle to work. Creating internal projects that push circular innovations is also a good initiative for the company to apply. These projects can also be a collaboration with other partners to share and learn from each other. Customer engaging is also important, VIJA Technology should share their vision to their customer, helping them understand the importance of their circular transition by advertising circular services (such as rental, take-back, maintenance).

Some initiatives that VIJA Technology could apply to improve their circular culture is going digital paperless. This method encourages employees to use digital documents in coordinating work projects. Paper and ink can be swapped out for an eco-conservative alternative such as Microsoft Office and Google Drive (Kielian 2017). In some cases, recycled paper would be an appropriate solution and printing documents double-sided would halve the amount of paper used. After used, all printed paper should be collected and sent to recycle factory.

5 DISCUSSION AND CONCLUSION

This research aims to design toolkits to assist companies in identifying circular opportunities and applying circular initiatives in their business. Based on the concept of circular economy and information from “The Circular Economy Handbook: Realizing the Circular Advantage” by Lacy (2019), toolkits have been created and tested on the case company. The toolkits can help companies understand the concept of circular economy, create a new circular business model with circular economy’s principles, suggest various circular design strategies as well as circular initiatives for development of circular journey.

In this thesis, the toolkits were designed with circular principles and circular guideline in mind. The toolkits focus on three important dimensions of a company included: Operations, Products & Services, and Culture & Organization. The five circular principles were integrated into the toolkits. In operation dimension, the toolkits focus on resources efficiency, renewable energy and system thinking (Ellen Macarthur 2013). In products & services dimension, the toolkit applied the concept of cradle-to-cradle with circular product design principles to help company design sustainable products (Braungart & McDonough 2002). After designing the toolkits based on the concept of circular economy, it was tested on the case company.

The testing result indicated that the toolkits is applicable and beneficial for companies. By using the toolkits, the case company was able to create a new business model similar to “product as services” circular business model presented by Accenture (2014). This new business model also applied “performance economy” principles (Stahel. 2019) where instead of selling physical ownership products, it will focus on selling its performance with circular services such as maintenance and replacement. Many circular initiatives were suggested for the case company in three dimensions (Operations, Products & Services, and Culture & Organization). The toolkits successfully pointed out weakness and strength of the case company each of dimension, from that helping company to exploit their advantage and improve upon.

The toolkit was proved to be worked, although depend on the company, its effectiveness and function could be various. The toolkits are recommended to use by companies that is unfamiliar with circular economy concepts or in their early stage of circular journey. For these companies, the toolkits can provide insight and examples of circular economy's practical, helping them to get start on their circular journey, similar to the case company. As for, mature companies who already understood and applied circular economy principles, the toolkits can be less effective less. Although, it can still act as a checklist for company to assess circularity in their company and find other circular opportunities to improve. In general, companies can transfer from linear business model into circular business models, redesign and improve products with circular design principles and embedding circularity into their companies' culture by using the provide toolkits.

Additional research is needed in order to increase the toolkit's effectiveness. The toolkits can be developed by adding important dimension such as ecosystem and legislation. Ecosystem dimension should focus on exploiting circular opportunities though company's partnership and collaboration. Legislation dimension can be essential for risk immigration and future proof product design. The toolkits can also be detail and thorough by adding more focus areas and questions. This can help various companies with different characteristic and mature level to utilize the toolkits, increasing its effectiveness.

With the popularity raise of circular economy, the need for toolkit to assist companies in transition from linear economy will be increase. Circular economy is a new concept for many countries, and it can be a difficult for many companies to applied circular economy principles into their business. This toolkit is the connecting between circular economy theory and its practical application, showing how companies can utilize circular opportunities. The toolkits presented in this research will help companies to accelerate their circular economy transition and building foundation for improved toolkits in the future.

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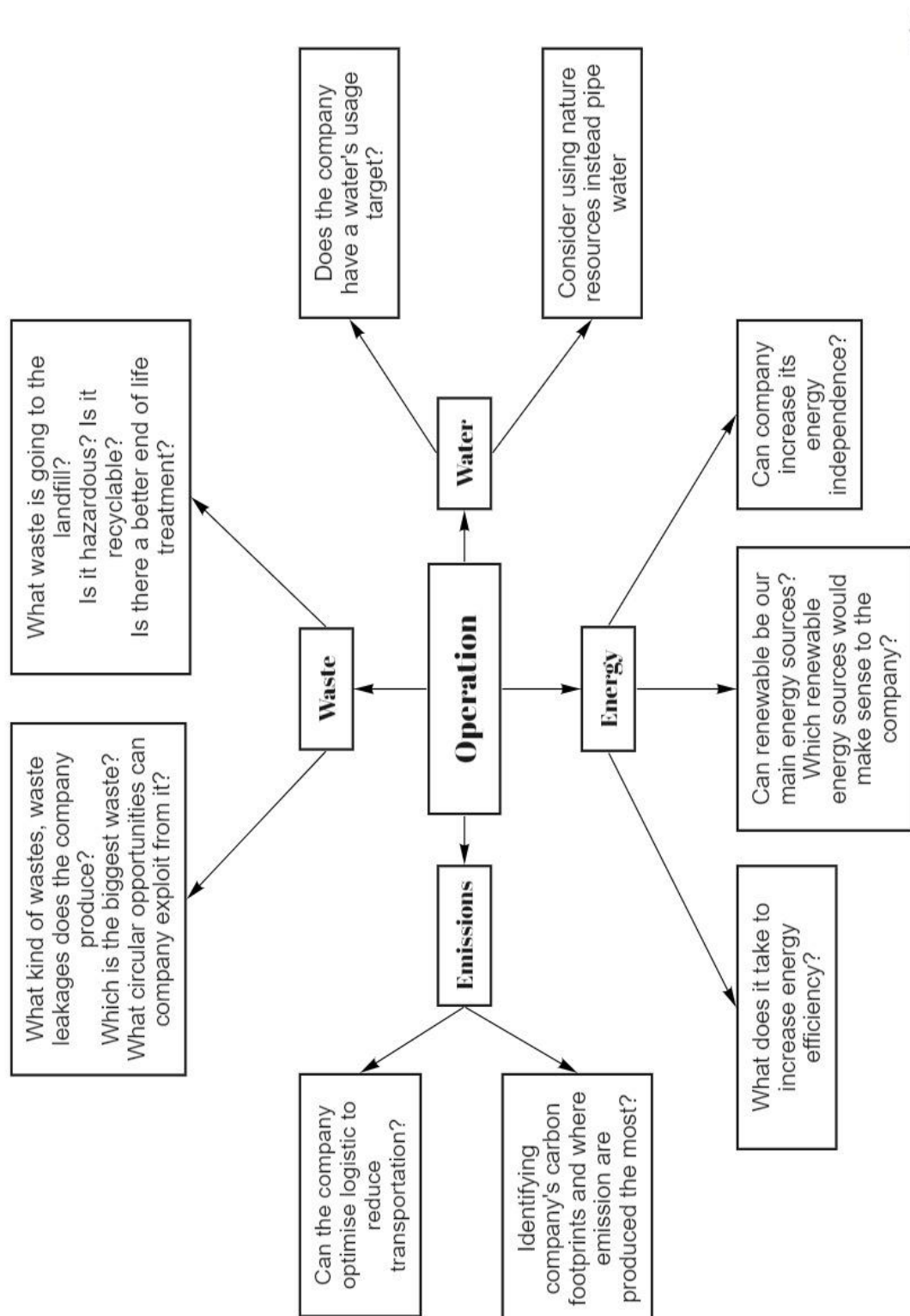
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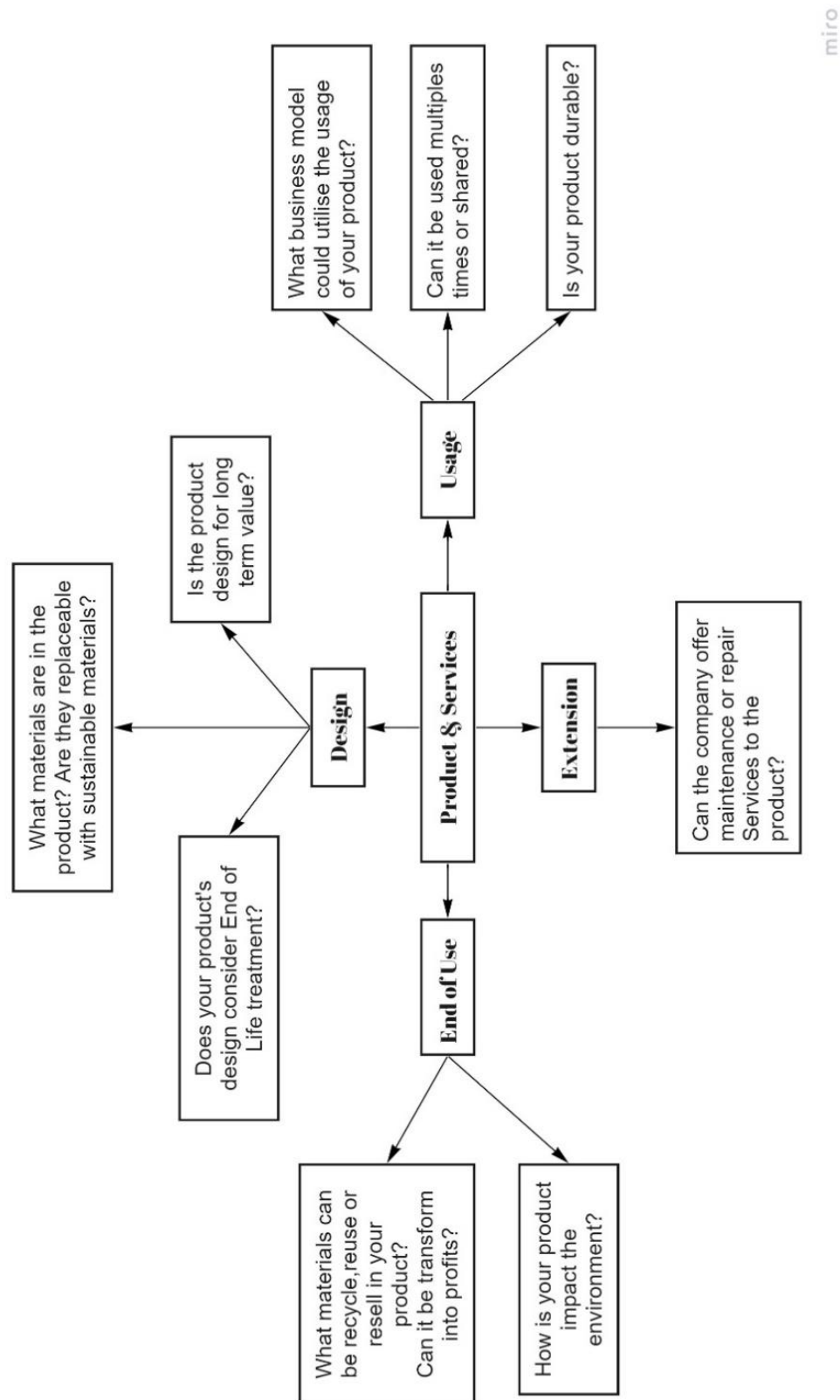
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APPENDICES

Appendix 1. Circular Economy Toolkits Mind Map: Operation



Appendix 2. Circular Economy Toolkits Mind Map: Products & Services



Appendix 3. Circular Economy Toolkits Mind Map: Cultures & Organization

