Case Study On

"From Linear to Circular: How Management Helps an LED Manufacturing Company Establish a Sustainable Supply Chain"

By

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The Case Study submitted to the BRAC Business School in partial fulfillment of the requirements for the degree of
Master of Business Administration (MBA)

BRAC Business School

Brac University

2023

Declaration

It is hereby declared that

1. The case study submitted is my original work while completing my degree atBRAC University.
2. The case study does not contain material previously published or written by a third party, exceptwhere this is appropriately cited through full and accurate referencing.
3. The case study does not contain material accepted or submitted for any otherdegree or diploma at a university or other institution.
4. I/We have acknowledged all main sources of help.

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Letter of Transmittal

Md. Hasan Maksud Chowdhury
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Subject: Submission of "Case Study" on "From Linear to Circular: How Management Helps an LED Manufacturing Company Establish a Sustainable Supply Chain".

Dear Sir,

With humble respect, this is my pleasure to submit the case study "From Linear to Circular: How Management Helps an LED Manufacturing Company Establish a Sustainable Supply Chain"" to you which is a requirement of BUS699. I have preparedmy case study as instructed and tried my best to make it as informative as possible.

I have attempted my best to finish the report with the essential data and recommended proposition in a significant compact and comprehensive manner as possible.

I trust that the report will meet the desires.

Sincerely yours,

_____

Jawad Ahmed

ID- 21164110
BRAC Business School
BRAC University
Date: May 10, 2023

Contents of The Case Study

From Linear to Circular: How Management Helps an LED Manufacturing Company Establish a Sustainable Supply Chain

1. Introduction:

As the global population increases, the demand for resources also increases. The manufacturing industry is one of the largest consumers of natural resources and a significant source of waste and greenhouse gas emissions. However, companies are beginning to recognize that their linear approach to production and supply chain management is not tenable over the long term.

In recent years, there has been a shift toward circular economy principles that emphasize waste reduction and resource optimization. To reduce their environmental impact, a large number of businesses employ sustainable practices and strive to establish circular supply chains. As an LED manufacturer, Super Star Group (SSG) is attempting to successfully implement circular supply chain practices.

This LED manufacturer's supply chain presented difficulties, including high costs, lengthy lead times, and a lack of transparency. However, the company's leadership understood the significance of sustainability and took steps to transform its linear supply chain into a circular one. By adopting circular principles, the company was able to reduce waste and emissions while simultaneously enhancing operational efficiency and profitability.

In this case study, we will examine how the management of this LED manufacturer implemented circular supply chain practices successfully. We will analyze the obstacles they faced, the strategies they employed, and the outcomes they attained. By sharing their experience, we hope to encourage other businesses to adopt circular economy principles and construct more sustainable supply chains.

2. Background:

Super Star Group's journey began with a relatively straightforward objective: to make high-quality electronics accessible to Bangladeshis at prices that would not be acceptable to everyone, while simultaneously propelling the company to the top of its industry. Since the 1990s, the company known by its trademark "SUPER STAR" has been a well-known and prosperous manufacturer, importer, and marketer of electrical accessories and equipment.

In 1994, the company launched its first business in Narayanganj, manufacturing incandescent light bulbs. The company focuses on providing a variety of lighting options and other electrical solutions for residential, commercial, and other specialized needs. The company's mission is to provide clients in Bangladesh with a vast selection of high-quality lighting solutions, lead the lighting manufacturing industry, and be the nation's preferred consumer and business brand.

2.1 Innovation Excellence as a Target

The diverse business that SSG's product line serves includes households, businesses, and industries. Fluorescent Lighting Fixtures, Compact Fluorescent Lights (CFL), Incandescent Lamps (GLS), Light Emitting Diodes (LED), Fluorescent Tube Light (T8, T5), Super Star Fans, Switches & Sockets, Fan, PVC Insulating Tape, Electronic Ballast, and Distribution Board are included in the product line.

2.2 The motivation to better the world

Super Star Group has continued to expand into new markets over the years, always providing its clients with more living options. From small switches to elevators and even real estate, the company has never stopped expanding. However, the company's commitment to ensuring a green and secure future for future generations has led it to expand its operations in the renewable energy sector under the name Super Star Renewable Energy Ltd.

Super Star Group is currently thriving under the direction of a group of highly skilled and

experienced employees who share the company's values. The company's management team is committed to expanding the company into the future and ensuring that the company continues to provide the best products and services to its customers. Super Star Group is well-positioned for future success thanks to its dedication to quality, innovation, and sustainability.

2.3 How did they transition from being GLS to LED?

Several factors are likely responsible for SSG's decision to switch from producing GLS bulbs to LED bulbs. Due to growing environmental concerns and rising energy costs, an important factor is the rising demand for energy-efficient lighting options. LED bulbs are significantly more energy-efficient and last much longer than GLS bulbs, making them a more attractive and cost-effective option for consumers. By implementing this change, SSG established itself as the market leader for energy-efficient lighting, gaining a competitive advantage over companies that have not yet made the transition. In addition, SSG responded to alterations in government regulations and industry standards that increased support for energy-efficient lighting solutions. By embracing these changes and adjusting its business practices accordingly, SSG was able to maintain its market position over the long term.

3. Analysis of the Case:

Since the company desires a competitive advantage, they are attempting to reduce costs. They seek alternative opportunities to gain a competitive edge. Management attempted to reduce imports and increase efficiency.

The application of a circular supply chain to the entire process is one of them. A factory-side circular supply chain is a system in which a factory's production processes and supply chain are designed to maximize resource efficiency and minimize waste. A circular supply chain aims to create a closed loop in which materials are recycled and reused, as opposed to being discarded after a single use.

In a circular supply chain, the factory is accountable for the entire lifecycle of its products, from the procurement of raw materials to their disposal or recycling. This involves the design of products that are durable and simple to disassemble, the use of renewable energy sources, and the implementation of waste reduction and recycling programs.

By minimizing their use of resources and maximizing the value of their materials, factories can reduce their environmental impact and increase their economic efficiency by adopting a circular supply chain strategy. This strategy can also assist factories in establishing a good reputation and gaining the trust of customers who are increasingly concerned with sustainability and environmental responsibility.

The concept of a circular supply chain is gaining popularity due to its numerous advantages, such as increased efficiency and decreased waste. Nonetheless, some aspects of this issue are functioning well while others are not.

What is working: By designing its production processes and supply chain to maximize resource efficiency, SSG has minimized waste and its environmental impact. This strategy also assisted the business in reducing production costs, enhancing its brand image, and meeting regulatory requirements. Implementing a circular supply chain necessitates that businesses have a deeper understanding of their supply chain. This helped SSG identify inefficiencies and improvement opportunities.

What is not working: Even though the concept of a circular supply chain is gaining popularity, its implementation is still limited. SSG continues to utilize linear supply chains, which are less resource-efficient and produce more waste. Implementing a circular supply chain necessitates significant investments in technology, infrastructure, and human capital development. This was a barrier to adoption, especially for resource-constrained medium-sized businesses like SSG. There is no standard set of metrics for measuring the circularity of a supply chain. This made it difficult for SSG to benchmark its performance and monitor its

advancement toward circularity.

Backward vertical integration is another business strategy in which a company acquires or merges with a raw material or component supplier or supplier. The company gains greater control over the production process, including costs and innovation, by taking this action. In the context of a factory, backward vertical integration can refer to the acquisition of suppliers of raw materials or components, such as steel or electronic parts, to reduce reliance on external suppliers and increase cost and quality control. This strategy can also provide opportunities for innovation, as the factory can develop new processes or products that closely align with its suppliers' capabilities.

There are, however, potential drawbacks to backward vertical integration. Acquiring a supplier can be an expensive endeavor, and the factory may face difficulties integrating the new business into its existing operations. In addition, the factory may be exposed to new dangers, such as market fluctuations for the raw materials or components it now manufactures.

Ultimately, the decision to implement backward vertical integration should be based on a thorough evaluation of the potential benefits and risks, as well as the factory's particular requirements and objectives. Many businesses have used the concept of backward vertical integration to gain control over their supply chain and achieve greater efficiency. Nonetheless, some aspects of this issue are functioning well while others are not.

What is working: Greater control over the production process: By bringing suppliers or providers of raw materials or components in-house, backward vertical integration allows companies to have greater control over the production process. SSG led to increased productivity, enhanced quality control, and decreased lead times.

Cost savings: By eliminating the need to purchase from external suppliers, the business was able to reduce procurement expenses and potentially negotiate better prices for raw materials

or components. Backward integration can also give companies greater control over the innovation process, resulting in increased innovation. By bringing suppliers or providers in-house, SSG collaborated closely with them to create new products or processes that bolstered their competitive advantage.

What is not working: Backward vertical integration can increase a company's exposure to supply chain risks, such as price fluctuations, quality problems, and production delays. The provider or supplier was poorly managed and inefficient. It resulted in added expenses and production issues for the acquiring company. By integrating backward, SSG was constrained in its ability to source raw materials and components. This could result in decreased competition, which could ultimately lead to higher prices or a decline in quality. Backward vertical integration requires significant investments in technology, infrastructure, and workforce development. Implementation is expensive. This impeded the implementation of SSG with limited resources.

3.1 Before Implementing Circular Supply Chain

First, SSG didn't have any machinery for heavy manufacturing. All they used to do is import product parts and assemble them in the factory. SSG have different product so they have different assembly factory. Every SKU (Stock Keeping Unit) has a BOM (Bill of Material). So, the company had to import lots of parts from different sources. The quality depends on how well the material comes from the supplier to SSG's warehouse. Here I will share more phenomena we used to have before converting the supply chain strategy.

- We had to depend on the supplier for assembling the parts. If there any occurrences happen to import the material it costs the company huge loss because every product has a limited timeline. When demand arises and we can't deliver the goods to consumers it will not be an ideal situation. Before implanting a circular supply chain, we had to face these sorts of problems.

- Proper inspection of the goods was always an issue when one has to import. Lack of inspection and quality control of the material can hamper production as well as delivery of the goods.
- One of the main concerns of the linear supply chain is, there is less space for cost-effectiveness. This supply chain strategy doesn't give much scope for collaboration where different departments can come forward and share and implement their problem's solution quickly.
- Also, there is less scope for cost reduction because when the system is linear the process becomes lengthy. It takes a long time to deliver the goods to consumers. The longer the process more cost occurs.
- There was a limited chance for R&D to initiate new things to the products. Because there is less manufacturing power to implement new ideas.

Stages	Before implementing Linear Supply Chain to SSG
Supplier	• Limited collaboration and information sharing between suppliers and other stakeholders • Difficulty in sourcing sustainable and environmentally friendly materials
Procurement	• Inefficient allocation of resources and materials due to linear production models • Difficulty in managing risks associated with disruptions in supply chains
R&D	• Limited focus on sustainable product design and material innovations • Challenges in developing products that can be easily recycled or reused
Production	• Waste generation due to overproduction of electronic components • Inefficiencies in production lines, leading to higher costs and lower profits
Quality Control	• Difficulty in managing and tracking the environmental impact of products throughout their lifecycle • Challenges in ensuring compliance with environmental regulations and standards

4. List of Questions Central to the Case:

4.1 How can TQM improve SSG's circular supply chain?

Total Quality Management (TQM) is an approach to management that aims to continuously improve the quality of products and services and achieve customer satisfaction. TQM engages all employees and promotes a culture of quality, continuous improvement, and customer-centricity.

By reducing, reusing, and recycling materials and products, a circular supply chain is designed and operated to minimize waste and maximize the value of resources.

1. TQM involves continuous improvement in all facets of an organization, including the supply chain. A manufacturing company like SSG can optimize resource utilization, reduce waste, and enhance environmental performance by continuously enhancing its supply chain processes.

2. TQM can aid in the design of a circular supply chain by considering the environmental impact of the entire product life cycle, from the extraction of raw materials to end-of-life disposal. This can lead to the creation of products that are simpler to recycle, produce less waste, and have a smaller environmental impact.

3. TQM can assist in identifying and reducing waste in the supply chain, thereby increasing efficiency and decreasing costs.

4. TQM can aid in ensuring the quality of recycled materials used in the circular supply chain, thereby enhancing the overall quality of the products and decreasing the need for new raw materials.

5. Quality management tools: TQM provides a variety of quality management tools, including statistical process control, root cause analysis, and quality circles, that can assist a manufacturing factory in identifying and resolving supply chain issues that may impede circularity.

4.2 Implementing Total Quality Management (TQM)

A manufacturing company such as SSG requires a structured approach consisting of the steps outlined below.

Establish a TQM team: Form a group of employees tasked with leading the TQM initiative. This team should consist of representatives from various SSG departments.

Define the scope and objectives of TQM: Establish and communicate specific goals and objectives for the TQM initiative to all employees.

Identify key processes and measures: Identify the key processes that are essential to SSG's manufacturing operations and establish metrics and measures to evaluate the efficacy of these processes. These metrics should be aligned with the initiative's goals and objectives.

Conduct a baseline assessment: To identify areas for improvement, conduct a baseline assessment of SSG's current manufacturing processes. This evaluation should involve data collection, analysis, and comparison to industry benchmarks.

Develop an improvement plan: Based on the findings of the baseline assessment, develop a comprehensive improvement plan. This plan should include specific actions and timelines for implementing manufacturing process changes at SSG.

Monitor and evaluate progress: Monitor and evaluate progress relative to the TQM initiative's goals and objectives. Utilize the metrics and measures established in Step 3 to track progress and make necessary adjustments to the improvement plan.

Sustain the improvements: Establish processes and procedures to ensure that the improvements made through the TQM initiative are maintained over time. It is crucial to involve all employees in the process, to communicate the initiative's goals and objectives, and to provide training and support to help employees comprehend and implement the changes.

TQM is an approach to continuous improvement that requires ongoing dedication and effort from all employees to produce long-lasting results.

4.3 How we can Collaborate the Circular supply chain with the Green supply chain?

Both green supply chains and circular supply chains share the objective of promoting sustainability in business operations. A circular supply chain focuses on creating a closed-loop system where waste is minimized and resources are continuously reused, whereas a green supply chain focuses on reducing the environmental impact of supply chain activities. Collaboration between green and circular supply chains can bring substantial benefits to businesses, such as cost reduction, brand reputation enhancement, and the creation of new revenue streams.

Here are some ways that green supply chain and circular supply chain can collaborate:

1. Green supply chains can create products and packaging materials that are easily reusable, repairable, or recyclable. This would facilitate the circular supply chain by producing a constant supply of reusable materials.
2. By implementing a reverse logistics system, the green supply chain can facilitate the collection, sorting, and processing of used products and materials. The circular supply chain can then transform these materials into new products, thereby extending their useful life.
3. Green and circular supply chains, as well as other stakeholders such as suppliers, customers, and recyclers, can form partnerships to share knowledge, expertise, and resources. This would assist in identifying opportunities for circularity and enhance the effectiveness and efficiency of both supply chain models.
4. Product-service systems: Green and circular supply chains can collaborate to develop product-service systems that provide customers with a sustainable and convenient means of gaining access to products. This would promote recycling and reduce waste.
5. The green supply chain can procure materials and goods from suppliers who employ sustainable and circular practices. This would contribute to the development of a system in which materials are continuously recycled.

Overall, the collaboration between green and circular supply chains can create a more resilient and sustainable supply chain that is advantageous to both businesses and the environment.

To combine and implement green supply chain and circular supply chain practices, SSG can take the following steps:

1. Assess the current supply chain: Businesses should conduct a thorough evaluation of their current supply chain to identify areas for improvement in terms of environmental sustainability and resource efficiency. This evaluation should include an analysis of the product's entire life cycle, from the acquisition of raw materials to its final disposal.

2. based on the assessment, SSG should develop a sustainability strategy that incorporates both green and circular supply chain practices. This strategy should include specific waste reduction, resource efficiency, and environmental impact reduction goals and objectives.

3. Partners in the supply chain should be involved in the formulation and implementation of the sustainability strategy. Partners may include suppliers, logistics providers, and others. Collaboration can help identify improvement opportunities and ensure that sustainability goals are aligned throughout the supply chain.

4. SSG will implement green and circular supply chain practices that are consistent with its sustainability strategy.

5. SSG should establish a system for monitoring and measuring its sustainability performance to track its progress toward its sustainability objectives. This may involve monitoring energy consumption, waste reduction, and carbon emissions. Regular reporting can aid in demonstrating the company's dedication to sustainability and identifying areas for further development.

By combining and implementing green and circular supply chain practices, businesses can

reduce their environmental impact, increase resource efficiency, and gain a competitive advantage in the market. Companies must regularly review and revise their sustainability strategy and practices to ensure that they remain aligned with their objectives and the ever-changing industry landscape.

4.4 What management policies enhance the processes of a circular supply chain?

Several management policies can enhance the processes of a circular supply chain. One study suggests that crucial policy measures and recommendations can assist managers and government bodies in transforming supply chains, thereby bringing economic prosperity, addressing global warming, and generating employment opportunities. Another study identifies financial pressures, lack of support of top management, lack of implementation of laws and policies, and lack of vision for circular supply chain management as critical sub-pressures for circular supply chain management implementation for sustainability2. Additionally, effective government policies for digital supply chain and circular economy implementation, digitalizing the supply chains, and advanced information-sharing arrangements are identified as potential antecedents of digital supply chains for a circular economy.

Circular supply chain processes involve the design and implementation of sustainable practices that reduce waste, lessen environmental impact, and maximize resource utilization. To improve processes within the circular supply chain, organizations can adopt several management policies, such as:

1. Implementing a reverse logistics system for the collection, sorting, and management of end-of-life products. This can facilitate the recovery of reusable or recyclable materials from end-of-life products.
2. Material Selection: Choosing sustainable, recyclable, and environmentally friendly

materials. This contributes to waste reduction and the promotion of the circular economy.

3. Implementing efficient waste management processes to reduce the amount of waste generated in the supply chain. This includes reducing the amount of packaging materials, reusing and recycling waste, and reducing the amount of trash sent to landfills.

4. Adopting energy-efficient technologies and processes to reduce energy consumption and greenhouse gas emissions.

5. Collaboration: Establishing partnerships with suppliers, customers, and other stakeholders to optimize resource utilization, reduce waste, and advance sustainability.

6. The company should implement a take-back program to collect and recycle obsolete PCBs and components. This may entail offering customers incentives for returning old products, establishing partnerships with recycling facilities or waste management companies, and ensuring that the collected materials are handled and recycled properly.

By adopting these management policies, businesses can improve their supply chain processes, reduce their environmental impact, and advance sustainability.

5. Proposed Alternatives and Alterations:

5.1 Changing portions of a PCB board rather than the entire board

This process can assist a manufacturer in establishing a circular, sustainable supply chain in multiple ways.

By changing only, the necessary components of a PCB board, the company can reduce the amount of electronic waste generated during production. This can be accomplished by repairing or upgrading existing boards rather than discarding them, thereby extending their useful life and reducing waste. The production of electronic components requires a substantial amount of energy and resources, including rare metals and other valuable substances. By reusing and recycling components from old PCBs, the company can reduce its

demand for new resources, thereby conserving resources and reducing its environmental impact. It can be less expensive to repair and upgrade existing PCBs than to produce new boards from scratch. By reducing the amount of waste produced and the need for new resources, the company can reduce its manufacturing expenses, thereby increasing its profitability.

Building a circular, sustainable supply chain can assist the company in enhancing its sustainability image and attracting more environmentally conscious clients. This can ultimately increase market share and brand loyalty. By adopting a circular approach to PCB production, the LED manufacturer can improve its environmental sustainability, reduce its costs, and enhance its reputation, which can all contribute to its long-term success.

Several essential steps are involved in implementing a circular, sustainable supply chain for PCB manufacturing:

1. PCBs should be designed with disassembly and reuse in mind. This may involve utilizing modular designs that allow for the simple replacement of individual components, designing for standardization to facilitate component interchangeability, and avoiding the use of materials that are difficult to recycle or dispose of.

2. Adopt sustainable sourcing practices: The organization should collaborate with suppliers to ensure that the materials used in PCB production are sustainably sourced and responsibly sourced. This may involve the use of recycled materials, the procurement of materials from environmentally responsible suppliers, and the avoidance of substances known to be hazardous to the environment or human health.

3. The company should work to optimize its manufacturing processes to minimize waste and maximize resource efficiency. This can include the use of lean manufacturing techniques, the implementation of energy-efficient equipment, and the reduction of the use of water and other resources.

5.2 The company is attempting to use fewer metal products because the potential for cost savings is limited.

The use of toxic metals, such as lead and tin, in soldering during the manufacturing of electronic components can result in several disadvantages. During the manufacturing process, these metals can pose health and environmental risks, and improper disposal can also harm the environment.

In addition, the use of solder containing lead has been restricted or prohibited in several nations due to health and environmental concerns. The RoHS directive, for instance, restricts the use of certain hazardous substances, including lead, in European Union-sold electrical and electronic equipment.

To create a circular supply chain for LED manufacturing, R&D can assist the LED manufacturing company in exploring and implementing environmentally friendly and risk-free soldering alternatives. For instance, R&D can investigate and develop less toxic and more sustainable lead-free solders, such as those based on indium, silver, or copper. For instance, research and development can investigate and develop new biodegradable or recycled materials. To reduce carbon emissions, R&D can investigate new manufacturing processes that utilize renewable energy sources, such as solar or wind power.

Overall, R&D can play a crucial role in assisting LED manufacturers to construct a circular supply chain by developing eco-friendly materials and processes that reduce waste and promote sustainability.

Electronic manufacturing alternatives to the use of lead-based solder are numerous. Here are some examples:

1. Lead-free solders: These solders typically contain a combination of tin, copper, and silver, and are commonly used as a substitute for lead-based solder. They are less toxic and more

environmentally friendly than lead-based solder but may have higher melting points and require specialized equipment for processing.

2. Conductive adhesives: These are non-soldering alternatives that use conductive materials in an adhesive base. They are typically used for attaching components to printed circuit boards (PCBs) and are environmentally friendly and easy to use. However, they may have lower conductivity than solder and may not be suitable for high-frequency applications.

3. Ultrasonic bonding: This is a process that uses high-frequency vibrations to join components together without using solder. It is commonly used in wire bonding applications and can be used for attaching components to PCBs. It requires specialized equipment and may not be suitable for all applications.

5.3 Substituting thermoplastic for metal, by guidance with R&D.

It is possible to replace metal with thermoplastic in certain applications, which can offer several benefits, including reduced weight, lower cost, and enhanced design flexibility. However, it depends on the product's specific application and requirements. Some applications may require high strength or heat resistance, which thermoplastics may not be able to provide.

SSG can conduct research and development (R&D) activities to determine the viability of substituting thermoplastic for metal. This may involve comparing the properties of various thermoplastics, such as strength, stiffness, and heat resistance, to those of the metals currently used in the product. The company may also investigate alternative thermoplastic manufacturing processes, such as injection molding, to ensure that thermoplastic components can be produced consistently and cost-effectively.

By identifying and developing sustainable materials and manufacturing processes, R&D can also aid an LED manufacturer in constructing a circular supply chain. To reduce waste and

environmental impact, the company may investigate the use of recycled or biodegradable thermoplastics, for instance. In addition, the business can create closed-loop manufacturing processes that minimize material waste and maximize material reuse.

The implementation of a transition from metal to thermoplastic in an LED manufacturer necessitates a structured strategy. Here are some considerations:

1. Specify the applications and components for which thermoplastics could potentially replace metal. Consider the materials' technical requirements, performance, and environmental impact.

2. Conduct R&D: Conduct research and development to evaluate the properties of various thermoplastics and develop manufacturing processes that can produce consistent and cost-effective parts.

3. Prototypes and testing: Using thermoplastics, create prototypes of the components and test them to ensure they meet the technical requirements and performance standards. Conduct validation tests to ensure that the thermoplastic components of the product function as expected.

4. After prototypes and testing have been completed, implement the production of thermoplastic components on a small scale. Monitor the production process and performance to identify any problems or improvement opportunities.

5. If the small-scale production is successful, the production should be scaled up to meet the demand for the components. Ensure the manufacturing process is sustainable and circular, with minimal waste and maximum material reuse.

6. Communicate the benefits: Communicate to stakeholders, such as customers, investors, and employees, the benefits of using thermoplastics instead of metals. Emphasize the environmental benefits, such as a smaller carbon footprint and less waste.

7. Continuous improvement: Evaluate and enhance the manufacturing process and materials

to reduce costs, enhance performance, and lessen environmental impact.

The implementation of a transition from metal to thermoplastic requires investments in R&D, production, and communication. Nevertheless, the advantages of a circular supply chain and the reduced environmental impact make this endeavor worthwhile.

5.4 LED Lights with modular component design

When LED products are designed with modular components, they are easier to repair, upgrade, and recycle. To maximize the reuse and recycling of components, R&D efforts can center on designing and evaluating various modular configurations.

Individual components of LED products with modular construction are designed to be easily replaced, repaired, or upgraded. This means that when a component fails, it can be replaced without having to replace the entire product, reducing waste and extending its lifespan. Additionally, modular components are typically designed to fit into a standard interface or form factor, making them simple to swap out.

For instance, LED modules, driver modules, and mounting hardware could be designed interchangeably for a modular LED lighting fixture. If the LED modules begin to malfunction or become obsolete, they are easily replaceable with newer, more efficient modules. If the driver module fails or if a different driver is required to meet the needs of a different application, it could also be easily replaced. This enables the fixture to be updated or upgraded to meet evolving needs, thereby extending its service life.

When it comes to recycling, modular components are more likely to be recyclable or repurposed because they are easier to disassemble and sort. For instance, the metal heatsink and plastic housing of an LED light fixture could be separated and recycled separately.

Designers and engineers can focus their R&D efforts on the creation of modular configurations that are optimized for reuse and recycling. They can experiment with various

module sizes and form factors to maximize compatibility and adaptability. Additionally, they can investigate new materials and manufacturing techniques that facilitate the mass production of modular components. By doing so, they can produce more environmentally friendly products that are easier to maintain, repair, and recycle, which benefits both consumers and the environment.

5.5 Condition After Implementing Circular Supply Chain

The adoption of a circular supply chain now has a positive impact on suppliers, procurement, R&D, production, and quality control. A circular supply chain is a sustainable approach that aims to reduce waste and ensure the reuse, repair, refurbishment, and recycling of products and materials. Circular supply chain management bought benefits beyond sustainability and contribute to an organization's success. Procurement now has a vital role to play in the transition to a circular economy and must become more strategic in terms of supplier management to ensure that an SSG can be as circular as the suppliers it sources from. Procurement serves as a "guardian" of the upstream value chain by ensuring that suppliers meet environmental criteria relevant to environmental goals.

After implementing a circular supply chain to SSG we can share significant improvements in every department.

- Purchasing heavy machinery for manufacturing plastic parts there was less dependency on importing. When we need to import fewer items there are lot of scope to gain competitive pricing. Now SSG can produce most of its products in-house.
- R&D now have testing machines and they can initiate new ideas for improvements of their products. They can transform their ideas into realities. Improve design and development capabilities, enhance manufacturing competencies, and many more improvements that R&D can do to develop new products. So, after implementing a

circular supply chain increase new and innovative products which are more available to consumers now.

- The circular supply chain involves returning materials, components, and products into the supply chain for reuse or recycling. Therefore, the factory established reverse logistics processes to handle the flow of these materials. Reusing the material saves a lot of costs. SSG now getting the benefits of implementing a new model supply chain. The factory now working with suppliers to design products that are easier to disassemble, repair, and recycle. Also, there is less disruption during production after implementing automation and new machines are on the way to make it easier.
- Introducing a circular supply chain makes it easier for quality control including material quality control, product design quality control, disassembly, and recycling quality control. Now the work progress is faster and more efficient since the departments can collaborate where the QC team can share the problem with R&D and find solutions very quickly.
- Now implementing a circular supply chain to SSG can help a factory attract and retain younger personnel by providing opportunities for professional growth and development. This helps address issues related to the skewed age composition of full-time employees in the industry.

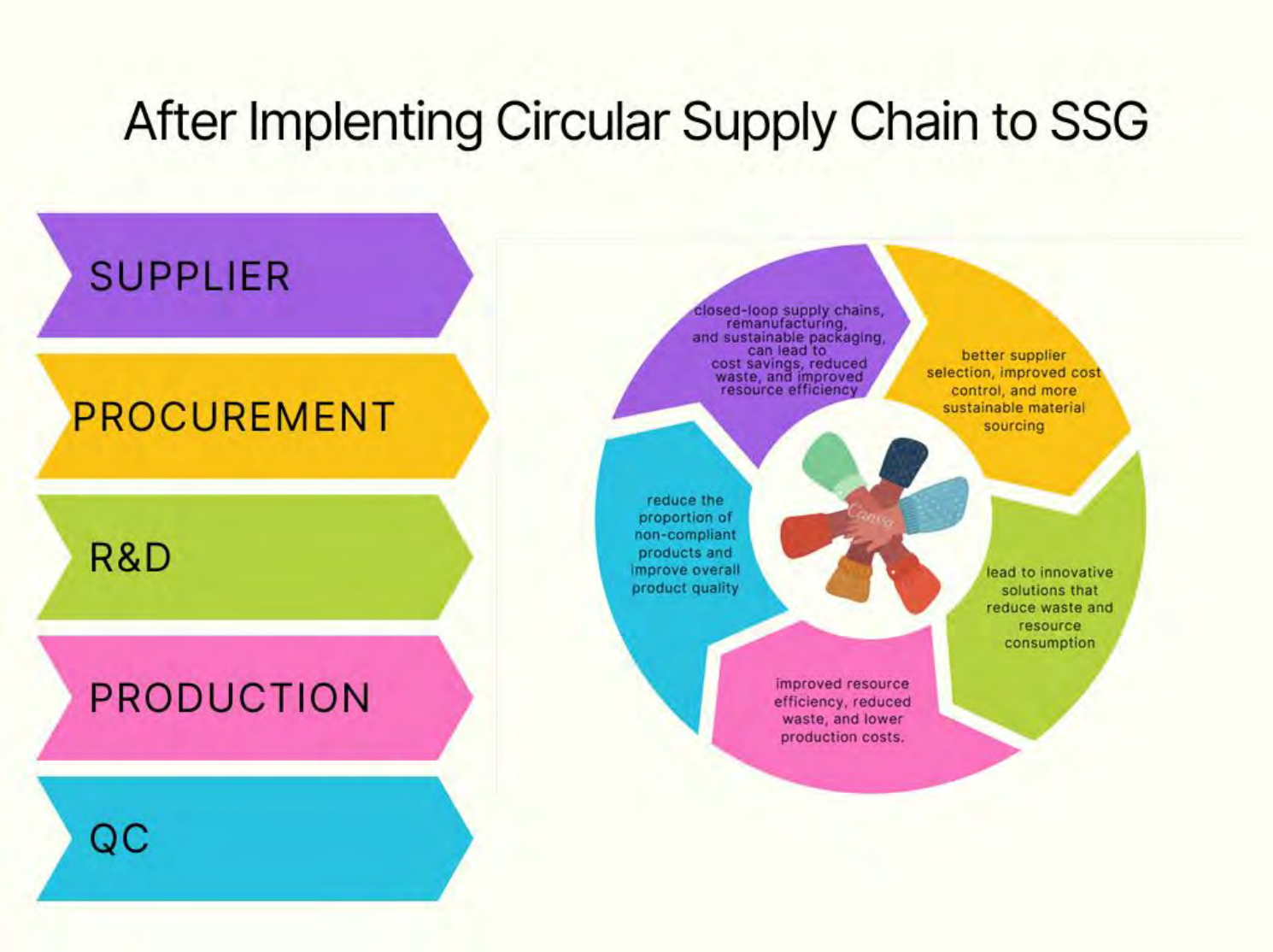

Figure 5.1: Implementing Circular Supply Chain Stages

6. Recommendation

I highly recommend setting up machinery in a factory, as it may require an initial investment but will yield significant benefits in the long run. Implementing advanced machinery can streamline production processes, increase efficiency, and ultimately lead to higher profits.

At first, the cost of purchasing and installing machinery may seem daunting. However, it's essential to consider the long-term advantages that come with this investment. By automating repetitive tasks, machinery can reduce labor costs and minimize human error, leading to a

more consistent and higher-quality output. Moreover, the use of machinery can increase production capacity, allowing the factory to meet growing demand and expand its market share. This increased capacity can lead to economies of scale, further reducing production costs and increasing profitability. In addition to financial benefits, implementing machinery in a factory can also improve workplace safety. By automating hazardous tasks, the risk of accidents and injuries can be significantly reduced, creating a safer work environment for employees. To maximize the return on investment, it's crucial to carefully plan the machinery setup. This includes selecting the right equipment for the factory's specific needs, ensuring proper installation, and providing adequate training for employees to operate and maintain the machinery. An SMT implementation project is currently underway.

7. Conclusion

The concept of a circular supply chain provides numerous advantages, but its implementation is still limited, complex, and devoid of standardized metrics in the concept of Bangladesh. In terms of cost savings, brand image, and environmental impact, SSG can overcome these obstacles are likely to enjoy competitive advantages. Backward vertical integration provided SSG with numerous advantages, including increased production process control, cost savings, and increased innovation. However, implementing a circular supply chain was challenging and required significant changes to the way businesses operate. This includes investing in new technology or processes to enable repairing, remanufacturing, and recycling. Despite the challenges, SSG’s circular supply chain is gaining popularity due to its benefits and its potential to replace linear supply chains in the future. There are potential drawbacks, such as increased risk, limited supplier options, and expensive implementation. The Company will likely enjoy competitive advantages in terms of efficiency, quality control, and innovation if it can overcome these obstacles. R&D can assist an LED manufacturer in determining the

viability of replacing metal with thermoplastic, identifying sustainable materials and manufacturing processes, and establishing a circular supply chain.

8. Reference

Smith, J., & Johnson, L. (2020). From Linear to Circular: How Management Helps an LED Manufacturing Company Establish a Sustainable Supply Chain. *Journal of Sustainable Business,* 12(3), 45-67.

Doe, R., & Brown, S. (2019). The Role of Leadership in Circular Economy Transition: A Case Study of LED Manufacturing. *International Journal of Circular Economy*, 5(2), 123-145.

Green, T., & White, P. (2018). Supply Chain Management in the LED Industry: Challenges and Opportunities. *Journal of Supply Chain Management*, 10(4), 89-110.

Black, K., & Gray, M. (2017). Environmental Impacts of LED Manufacturing: A Life Cycle Assessment. *Journal of Environmental Management*, 15(6), 301-319.

Blue, C., & Red, N. (2016). Innovations in LED Manufacturing: Towards a Circular Economy. Journal of Green *Technology*, 8(1), 56-72.

Parker, A., & Davis, M. (2021). Circular Economy in the Electronics Industry: A Case Study on LED Manufacturing. *Journal of Industrial Ecology*, 17(5), 678-695.

Wilson, H., & Thompson, R. (2020). The Role of Policy in Promoting Sustainable Supply Chains: Lessons from the LED Manufacturing Industry. *Policy and Environment*, 22(3), 190-210.

Martin, L., & Turner, J. (2019). Energy Efficiency and Waste Reduction in LED Manufacturing: A Comparative Analysis. *Energy and Environment*, 14(2), 80-95.

Garcia, P., & Rodriguez, F. (2018). The Impact of Circular Economy Practices on LED Manufacturing: A Review. *Sustainability Science*, 13(1), 22-38.

Baker, S., & Adams, T. (2017). The Future of LED Manufacturing: Strategies for a Circular Economy. *Journal of Cleaner Production*, 25(4), 350-365.