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Sustainable Innovation for Reducing Negative Environmental Impact in the Textile Industry

A Comparative Case Study Between Sweden and Bangladesh

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Abstract

This thesis attempts to highlight the challenges and share insights related to sustainable innovation in the textile industry, as well as the importance of collaboration and technology adoption to reduce negative environmental impact. The comparison between Bangladesh and Sweden, a developing nation and a developed nation, sheds light on the importance of design thinking, the use of technology in supply chain management, as well as the necessity of government support and customer awareness. The issues addressed by the textile sector, such as the high costs of sustainable materials and the necessity for government assistance and open business procedures, are shared by the literature analysis and semi-structured interviews with various textile manufacturers in both nations. The relevance of environmentally friendly activities, such as employing sustainable materials, lowering water and energy consumption, enhancing worker safety, and addressing waste management, is important to achieve positive environmental effects, according to the results and empirical study.

Keywords

Sustainable Innovation, Textile Industry, Positive Environmental impact, Challenges, Developed country, Developing country.

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1 Background

Among the industries still significant in the world, the Textile industry is one of them. It also has a long history with huge contributions to human civilization history. About 28000 years ago first evidence was discovered that the development of textiles evolved in the Paleolithic era (Barber 1991). The article also highlighted that over time civilization was improved by humans to create advanced and sophisticated textile materials which has a huge contribution towards cultural development. In recent years industry become big and start to have a bigger impact on the global economy, one of the main indicators to understand how industry influences the global economy is GDP (Gross Domestic Product). According to Keane and Velde (2008), the estimated contribution from the textile industry to the world's GDP is up to 4% which differs from country to country for example 12% in Cambodia and 15% in Pakistan. The textile industry also provides the largest employment opportunities, and the ratio varies depending on how developed the countries are. In the USA the industry employs 500,000 people which generates over 25 billion USD in annual revenue. On the other hand, in a developing country like Cambodia, 90% of employment comes from the textile industry (Keane and Te Velde, 2008).

Textile production process builds through the use of natural resources from the earth and has a close connection to the environment. During production, it spreads a lot of elements into the environment which raises the question of whether the elements are having a positive impact or damaging it further. The concept of Sustainable Innovation takes place when the textile production process or materials are introduced from a more moral and social responsibility perspective. It is to ensure that the products are created in a way that is not harmful to the environment and the people who manufacture them. Also, globalization makes the textile industry wider and more complex, it is often connected between countries where some developed country source products from developing countries, and some developed countries use advanced technology in the production process and utilize the resources with moral and social understanding where the aim is to reduce negative environmental impact.

Here in this report, we will look over the two most important producers of textiles Sweden and Bangladesh. Both countries are chosen to have a comparison on how developed countries and developing countries act on environmental issues based on Sustainable Innovation. A report from World Trade Organization mentioned an assessment from 2020 that the textile industry has huge contributions to the history, culture, and economics of both Sweden and Bangladesh.

Over 200,000 people are employed by Sweden's textile industry connected from production to selling, contributing about 4% to the nation's GDP. On the other hand, Bangladesh, which accounts for around 80% of all exports from the nation, is one of the world's top producers of clothing and textiles. Millions of people in Bangladesh depend on the textile sector as a key source of employment and income, and it has significantly contributed to the country's efforts to fight poverty.

A comparison between Sweden and Bangladesh will help us to understand what the challenges are to implement more sustainable innovation in the textile industry in different circumstances. Also, how can we take learnings from each other to ensure more use of sustainable innovation? Developed countries have the resources, technology, and infrastructure to create more sustainable fashion products while developing countries often lack these resources and are unable to produce sustainable textile products at scale. Achieving sustainability is significantly more difficult because these nations have vastly different resources and regulatory systems. This study looks at the current business strategies used by the Textile industry in Sweden and Bangladesh, compares how well those tactics performed in terms of the environment, and makes suggestions for future directions that could improve sustainability and enable companies to increase profits while also benefiting society.

2 Problem Discussion

Environmental issues are now essential to address especially when we are concerned about climate change, global warming, and greenhouse gas emission. Unsustainable innovation in textile production can negatively impact the environment. Many processes and materials used in production are often run-on fossil fuel which causes serious environmental damage and other climate issues (Cherrafi et al. 2018). Also, the production of the products uses hazardous chemical such as lead and cadmium which is most of the time toxic to humans and the environment.

In one way the business needs to develop new techniques, products, and technology in order to continue to be more competent and focus on fulfilling customers' expectations at the same time they also need to find the balance to have less environmental impact is often a constant battle.

Sustainable innovation, which is described as "new procedures or processes that improve efficiency, raise output, or reduce waste, while also conserving or restoring natural resources and sustaining a healthy environment," is one approach for firms to accomplish this (Claxton & Kent, 2020). But putting sustainable innovation concepts into practice sometimes necessitates a sizable initial investment. To decide if sustainable innovation makes sense for their business at this moment, companies need to balance the implementation costs and potential rewards connected with it. Sometimes it may be seen that businesses can save money on materials and energy also produce better products and conventionally access new markets but in the long run, it is going to be a big risk to act on them. A study by Huynh et al. (2022) found that businesses in the textile sector often hesitate to invest in sustainable innovation due to a lack of financial incentives and a lack of awareness of the possible advantages. Companies may also be reluctant to invest in sustainable innovation because of the implementation's alleged high cost and complexity. Also, the industry often tries to put more focus on selling rather than its supply network, especially investing in Sustainable innovation mainly for slower visibility of the results from the investments. This also involves the supply chain's lack of knowledge and resources to apply sustainable innovation to their production processes (Gamidullaeva & Doszhan, 2020). The competitiveness of the industry is making it harder for the company to engage in big sustainability projects.

The lack of market demand for sustainable fashion items plays a vital role in not concentrating on sustainability in the textile industry. The different company expresses their sustainability information in a different way which creates it more complex for the customer and reduce the interest in understanding and promoting sustainably sourced textile. On the other hand, many nations show less interest in putting a priority on sustainable innovation for environmental problems in the Textile sector. This is caused by several things, such as a lack of knowledge and understanding of how the Textile industry affects the environment, a lack of financial incentives for businesses to adopt sustainable business practices, and a lack of government regulations and policies that support sustainability (Melane et al., 2020). It also varies depending on the country's economic standards. Most developing countries are often conflicted between tackling poverty and economic growth with Implementing Sustainable innovation. Developed countries also struggle to balance economic growth and sustainability in the race for industrialization. It is also difficult to foresee a long-standing manufacturing technique that is ecologically sustainable but does not bring short-term profits to the business (Wieczorek, A. J. 2018).

Politics and national concerns also play a significant part in this situation. In developing nations, political instability, corruption, a lack of official backing, and a lack of knowledge about environmental issues prevent the adoption of sustainable innovation. On the other hand, political polarization, and resistance to changing from traditional production methods in developed countries can be a threat to their short-term profitability and make it challenging to implement policies that encourage sustainable practices between countries regardless of geographic location or economic status. In comparison to poor nations, developed countries have stricter trade rules, which puts obstacles in the way of aiding and trading sustainable practices globally (Hudson, R. 2002). Also, some political leaders are only concerned about short-term growth instead of long-term sustainability allowing the public and organizations to stay in the diffusion that it is ok just to focus on one part of the world rather than taking a holistic perspective.

Sustainable industrial innovation is crucial for maintaining the environment, health, and well-being of the global population as well as for the economic development of nations. As the second highest polluting industry after the oil sector, emphasis should be even higher on sustainable innovation. The manufacture of many types of clothes and associated items, as well as a sizeable amount of the world's resource usage and pollution, are all attributed to the textile industry. Consider Earth to be a spaceship traveling across the universe with all of us on board and limited resources. Given that there is a chance that the resources may run out and put our ability to survive in jeopardy, human nature will lead us to put our survival first by ensuring that the resources are used effectively and by figuring out how to create a system of production that would enable us to survive for generations on end on the resources that are left. We must use Earth's resources properly and sustainably. This metaphor depicts how all life on Earth is intertwined and dependent on one another, and how we must work together to ensure the survival of our planet and all its people. According to an article by Harris et al. (2016), we are already accustomed to believing that supplies for sustainable textile goods are limitless and boundless. If we do not handle the issue now, when the world is already alarming due to natural disasters, our survival may face a significant struggle in the future.

Among all the problems stated here one of the major problems is how to address the issues, where to address and whom to address them. The research is aiming to highlight the issues and possible suggestions for the problems by comparing Sweden and Bangladesh.

3 Purpose and Research Question

Innovation and Sustainable Innovation are two topics that are closely related but still have thin differences and perspectives when it comes to the textile business. According to Lu and Wu (2010), innovation is typically used to describe the introduction of new goods, services, or procedures that have the potential to fundamentally alter the way things are done. Sustainable innovation also refers to the creation of solutions that are environmentally conscious and have the potential to produce long-term economic and social benefits. While sustainable innovation is primarily concerned with developing solutions that address the difficulties of our changing environment, innovation is frequently motivated by a desire to create something new, boost efficiency, or solve a problem. According to the article, the use of renewable resources, the creation of effective technology, and the adoption of sustainable behaviors are all examples of sustainable innovation. Due to global warming, people make efforts faster to lessen the unfavorable environmental repercussions of present activities, and the idea of sustainable innovation is gaining importance. In this study, our focus is only on Sustainable innovation which connects to the environment.

The report from World Bank based on a study from 2021 mentioned that Sweden has considerably improved its ability to decrease air pollution since the 1970s. Sweden has the cleanest air in Europe (m3) in 2019, with an average of only 8.3 micrograms per cubic meter. The World Health Organization (WHO) advises no more than 10 micrograms per m3, which is far lower. Sweden has also made efforts in reducing greenhouse gas emissions, with a 40%+ drop in emissions per person since 1990 (World Economic Forum, 2021). On the other hand, Bangladesh as the second largest exporter of textiles in the world. The industry has an enormous impact on pollution of the pollution, one of the parameters is air pollution where the textile industry is causing 10% of the total country’s air pollution. A study by Ali et al (2021) also discovered that the country's overall water contamination is caused by the textile sector to a degree of 10%.

To preserve the textile industry's long-term sustainability, both industrialized nations like Sweden and rising ones like Bangladesh largely rely on innovation. Innovation has been used in Sweden to create sustainable fashion solutions that improve working conditions and reduce adverse environmental consequences (Stål and Jansson 2017). Also, to decrease the environmental impacts of their manufacturing processes, Swedish enterprises have adopted the concept of the circular economy (Stål and Jansson 2017). In Bangladesh, innovation has been

used to improve working conditions and increase production in the apparel industry (Masud et al., 2019). The author notices a stark distinction between these two countries' strategies for applying sustainable innovation in this field. The paper by Macchion et al. (2017), which demonstrated a favorable and significant influence on the development of innovation performance through environmental practices in the textile industry, also served as inspiration for the author.

It is important to compare a developed county with another developing country which may highlight different strategies that have been adopted by nations. Comparing those strategies will also help us to find out the areas that need improvements and we will put some suggestions or directions based on the research. There is a chance for the two countries to work together to create ground-breaking ideas that benefit both. Because these countries' resources and legislative frameworks varied widely, so therefore achieving sustainability is much more challenging. The paper suggested looking at cross-country effects and how sustainable innovation might help address negative environmental problems. Thus, the primary goals and research question are as follows -

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1. What are the common challenges faced by the Textile industry when it comes to sustainable innovation?

2. How can the Textile industry increase using sustainable practices to reduce negative environmental impact?

4 Literature Review

The textile industry has a huge impact on the global environment, gradually the world is moving towards sustainability which creates extra pressure for the textile industry to adopt more sustainability. On a global scale, the textile industry is responsible for a large amount of water, energy, and chemical consumption. Only cotton production alone accounts for 2.5% of total water consumption and 8% of the world’s total pesticide use. Also, the use of synthetic fibers

has led to microplastic pollution in the environment. There is still a lack of demand for sustainable clothing interest is raising among customers due to global warming and other environmental issues. Companies are also forced to take sustainability seriously. According to the article by Baldassarre et al., (2017), Organizations have recently begun to recognize the significance of sustainable innovation as the focus on climate change and environmental sustainability has increased. This includes using organic cotton, recycled polyester, and other sustainable fabrics, as well as using more efficient and environmentally friendly production methods. It is also focusing on reducing waste. There are also changes in the production techniques for example using fewer natural resources and recycling before exposing them to the environment. Recycling and investing in closed-loop production are also getting more popular with some retailers. Over time natural fibers are getting popular due to their biodegradable nature, they also need less energy and water during textile production. Innovations are taking its space to make the textile industry more competitive and to achieve sustainability. One example is fishing nets are being used as material for making the fabric and plastic bottles are being used to make the fiber. Utilizing digital technology to cut waste is another way that the Textile industry is developing sustainably. For instance, businesses are utilizing 3D printing to produce custom-fit clothing with less waste (Kozlowski et al., 2012). These sustainable innovations are taking place in the textile industry, but the practical use differs between countries based on the country's geographic area or financial stability. That is a big gap the author found while doing the report.

On the other hand, Businesses are trying to promote digital platforms to link consumers with used clothing, allowing them to purchase used items rather than new ones. The aim is to make less clothing ends up in landfills and its lifespan is extended. This requires developing systems for collecting used clothes and turning them into new products, as well as creating goods with long-term use in mind (Kozlowski et al., 2012). This also helps consumers to purchase fewer items while still having access to fashionable things and lowers waste.

Innovating sustainably considers how products and services will impact the environment, the economy, and society. According to Baldassarre et al. (2017), sustainable innovation aspires to create solutions that are financially viable while safeguarding natural resources and furthering societal advantages. In response to this transition, businesses have funded R&D initiatives aimed at developing novel ways to reduce energy use, create alternative energy sources, create eco-friendly goods, and improve manufacturing processes (Hermann et al., 2016). The results of this effort have led to the development of new technologies that enable more efficient

resource usage. Consumer awareness of the need to promote sustainable behavior is growing. Governments have begun public relations initiatives to encourage individuals to practice sensible consumption practices including recycling, taking public transportation, and employing green technology (Chang et al., 2016). Here is also not all these great initiatives are not similarly applicable to all the country but the greater impacts are being connected to the whole world. Therefore, for the sector to lessen its environmental impact and stay competitive in a rapidly changing industry, sustainable innovation is crucial. More so it is a must to make sure the implementation is spreading to every part of the world.

4.1 Textile Industry

As one of the oldest industries textile industries has significant contributions to the economic sector, and the contribution expedites through globalization. It is very hard to estimate the exact numerical aspect of the contribution. One of the reasons is the industry offers a wide range of products and services. It is also spread all over the world for different reasons. For example, after the production, the supplier starts to pack to ship to its global destination which involves shipping, supply chain, and distribution part. In this report, we will only look over the production part where we will compare Sweden's Textile industry Vs Bangladesh's textile industry.

The process of producing textiles is intricate and involves several locations that link in various ways depending on the procedure. This chart describes textile manufacturing in a conventional manner, which is typically utilized by mass production or quick fashion. It shows where textile production begins and where it concludes. The environment plays a varied role in each step. For instance, a hazardous chemical might be used in the dyeing process, thus for that process, the textile manufacturers concentrate on how to neutralize the chemical before releasing it into the environment. Fewer pesticides should be used during harvest to preserve the organic form.

However, the World Trade Organization estimates that the worldwide market for textiles and clothing was worth $741 billion in 2018. The textile industry has a wide range of processes and procedures, including the production of clothes and other goods as well as fibers and textiles. The textile manufacturing facility includes all the following processes: spinning, weaving,

knitting, dyeing, printing, and finishing of textiles, as well as sewing and cutting of clothes (Prakash et al., 2020).

Figure 1: Textile products Life Cycle URL

Recent years have seen a tendency in the business toward greater innovation, including automation, digitalization (RFID, 3D printing, artificial intelligence, or AI), and sustainability. Research from the National Textile University indicates that the industry is depending more and more on digitalization to increase productivity and efficiency. Artificial intelligence, RFID, and 3D printing are a few examples of digital technologies that can make radical changes in the industry. Thanks to this technology, manufacturers can now track inventories and production in real-time and improve manufacturing processes. Furthermore, digitization has enabled enterprises to enter new markets and expand their client base. Connecting to lessen negative environmental impact, the author analyzes only sustainable innovation that helps reduce environmental damage.

4.2 Sustainable Innovation in Textile Industry

As we see an increasing expectation for the textile industry to move towards sustainability new products, materials, techniques, and technologies are being developed. This also aims to reduce environmental damage but on a very small scale and differs in different countries. The more we are into globalization the possibility to utilize different countries more depending on the demands. But at the same time, this possibility needs to be measured with the same standard that every country is taking the same measure to reduce negative environmental impact. Sustainable textile innovation is often known for using natural resources like plants and alternative materials like soy-based fibers or recycled wood pulp. These materials are suitable for a variety of applications since they are usually more breathable and lightweight than conventional textiles (Rese et al., 2022). The article also noted how new technological breakthroughs have facilitated the development of sustainable textile technologies. "Nanotechnology, for example, has enabled the fabrication of materials with greater strength and durability while simultaneously decreasing their environmental imprint," Additionally, innovative printing techniques have made it possible to create fabrics with distinctive patterns and colors while still using renewable resources.

There is a very fine line between Sustainability and Sustainable innovation. Sustainability often refers to a practice to be mindful of the present generation for the future generation. This includes balancing human activities towards climate change, pollution, utilizing resources, and social inequality. So, it comes with various aspects like social sustainability, environmental sustainability, economic sustainability, and many more. On the other hand, Sustainable innovation refers to goods, processes, or services that consider the economic, social, and environmental effects of products and services and aim to balance out their positive and negative effects. Utilizing renewable resources, creating efficient technology, and implementing sustainable behaviors are all examples of sustainable innovation. In this context, this report only looks through the sustainable innovation part in the textile industry where new products, services, and techniques influence the reduction of environmental impact. Several possible advantages include enhanced environmental performance, economic expansion, and social gains. For instance, sustainable innovation may result in the development of textiles that use fewer toxic chemicals, are more resource-efficient, and leave a smaller environmental footprint (Asgary et al., 2020). Furthermore, sustainable innovation may guide the evaluation

of new value chains and business ventures, enhancing the profitability and productivity of the industry.

According to Panigrahi et al. (2018), 16% of consumers were aware of environmentally friendly textile products and the benefits they offer. The implementation of sustainable textile innovation in the textile sector is fundamentally hampered by this lack of customer understanding. Although there may be less consumer demand for sustainable textiles, informing consumers and promoting awareness to prevent long-term environmental disasters is still critical. This is akin to drinking water; even if customers are unaware of the need to do so, they still need to survive over the long run and be healthy. Lack of consumer awareness can therefore be addressed by firms' CRP to inform customers and help them make wiser decisions.

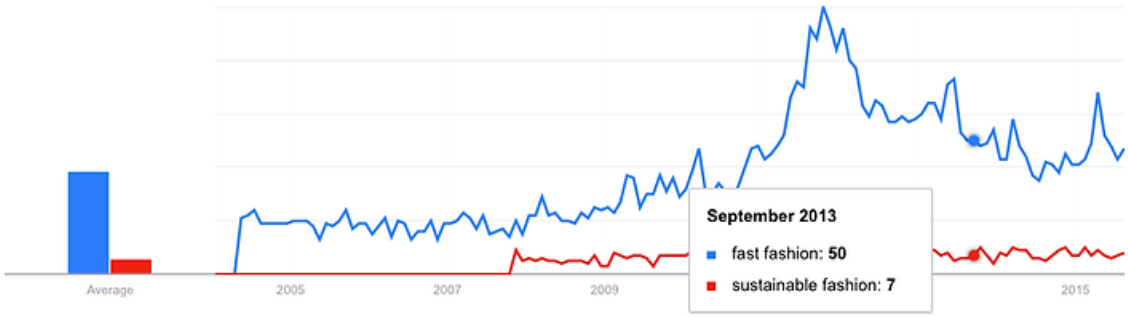

Figure 2: Fast Fashion Vs Sustainable Fashion Demand. Source: URL

Customers' lack of interest in sustainable clothing also triggers by the higher price of sustainable products. The production of sustainable textiles is frequently more expensive than the production of conventional materials due to higher material costs and the requirement for new technologies and procedures (Huang et al., 2021). This is a substantial barrier to the textile industry's adoption of sustainable textile innovation since some businesses may find the higher costs of sustainable production to be unaffordable. The production of sustainable textiles is not currently supported by any laws or financial incentives (Panigrahi et al., 2018). Due to the uncertainty of government support, businesses may be reluctant to engage in sustainable production, which creates a substantial barrier to the textile industry's adoption of sustainable textile innovation.

4.3 Environmental Impact on Textile Industry

Despite being a dominant industry in the economy textile industry has the tag to be one of the most ecologically harmful industries in recent days. This increases the concern among social and environmental activists and the textile industry is pushed to innovate a variety of creative ways to lessen the environmental impact. It is also hard to understand what the parameters are to measure the environmental issues of the textile industry. Starting with decreasing the environmental effects of the manufacturing process, like cutting back on reuse water and energy savings, improving waste management, and using fewer dangerous chemicals, is one technique. By using more effective technologies, eco-friendly materials, and best practices in manufacturing processes, this might be achieved. Focusing on textile lifecycles concerns, such as promoting secondhand textiles and recycling as well as the use of more sustainable materials, is an additional tactic. The development of innovative biodegradable or recyclable textiles, the use of natural dyes and plant-based materials, and the implementation of regulations for more ecologically friendly textile production and disposal might all be examples of this.

An article by Chen et al. (2021) talked about some of the measuring tools to understand the environmental impact of the textile industry. The textile industry offers many opportunities for innovation to achieve sustainability, but first, we must comprehend how to measure whether the environmental impact is getting better. There are several ways to evaluate the textile industry's positive environmental impact. The amount of greenhouse gases produced during the production and consumption of a good, service, activity, or organization is known as its carbon footprint. A carbon footprint analysis of a textile firm or product can provide information on the environmental issues of the products and processes.

The entire amount of freshwater required to produce a good or provide a service is measured as the "water footprint" of that good or service. It includes all sources of water as well as all forms of water pollution connected to its creation. Analyzing the water footprint of a textile firm or product can share insights about the environmental impact of manufacturing. Also, the total amount of waste produced by a product, service, activity, or organization is measured as its "waste footprint." Analyzing the waste footprint of a textile firm or product can provide information on the environmental impact.

The term "resource footprint" refers to how many resources are used generally by a given product, service, activity, or organization. Understanding the environmental impact of the production and use processes may be gained by calculating the resource footprint of a textile

firm or product. And the total amount of pollution that a product, service, activity, or organization emits into the environment is measured as its "pollution footprint." Understanding the environmental impact of the production and use processes may be gained by calculating the pollution footprint of a textile firm or product.

Usually, these types of pollution are taking a long time to have a visible impact on the environment. So, it is challenging to set up measurement criteria and follow up on them to ensure that we positively impact the environment through textile production. So often we see that one area of measurement tools is highlighted to describe the overall situation. In that case, the urgency and importance are often diverted which makes the long-term actions delayed or unspoken. One example we found is in Bangladesh. Where the area of dying and washing units of textile production water level is much lower compared to another area where there is no textile production. This is highlighted in a DW documentary where they mentioned that a country like Bangladesh, Cambodia, and Pakistan which are depending on agriculture is facing a huge water crisis due to overwater consumption in Textile production. The dying and washing areas also cannot conduct fishery due to a lack of fresh water since the polluted water is discharged into rivers which makes the environment toxic not only for fish but also for humans.

4.4 Textile Industry in Bangladesh

Bangladesh's involvement in the textile industry dates to the 18th century when it first started to produce textiles. The country was well known for producing muslin, which was in great demand by foreign buyers across Europe. In the nineteenth century, jute was originally produced in Bangladesh and afterward used to make yarn and paper. Bangladesh has earned an international reputation as a significant textile and apparel maker by the 20th century. Following the independence struggle, Bangladesh's ready-made clothing sector, which had started to concentrate on producing items for exporting in the 1970s, received a lot of attention. This change made it easier for the nation to move from an economy based mostly on agriculture to one focused on manufacturing and industry, which led to increased employment and economic growth.

According to a WTO assessment, the garment sector accounts for over eighty percent of Bangladesh's exports and a sizeable amount of its GDP. The sector employed around 4.2 million people in 2018 and exported items worth over $30 billion. Since the Multi-Fiber Strategy was

put in place in the early 1990s, Bangladesh's garment sector has grown remarkably. This agreement permitted the apparel sector to grow without restrictions by eliminating quota restrictions. Bangladesh's apparel industry has made strides in eradicating poverty. The World Bank claims that the sector has helped to reduce poverty, which has decreased from more than 40% in 2000 to just over 20% in 2018. The sector has also demonstrated success in improving the lives of those who work in the industry.

Another important fact about Bangladesh’s textile industry is that industry is connected to almost all other financial sector and have a huge impact on the economic stability of the country. Since it generates so much foreign currency it is connected to the banking sector to the foreign currency reserve of this country. The country has built a huge infrastructure to support the textile industry to build many different zones so that the production facilities are not interrupted and have a secure place.

4.5 Sustainable Innovation in Bangladesh’s Textile Industry

The textile industry in Bangladesh needs sustainable innovation to thrive. The growth of technological advancement has made it simpler to monitor and analyze the country's industrial process. However, innovation hasn't focused on limiting negative environmental consequences yet; instead, it has prioritized profitability above efficiency. A report from Jewel et al. (2022) mentioned that significant importance is given to innovation rather than sustainable innovation. Also, it stated that within sustainable innovation majority of the focus is on how to maximize profitability and ensure the company’s growth. The environmental impact is often challenged on how to address it in certain ways where it has been highlighted to related concerns.

According to a recent report by the Sustainable Clothing Coalition, with almost 3,500 facilities employing over 3 million people. The government's initiatives to promote the sustainability of the country's textile and garment industry have not yet been fully successful. Nowadays, only a very small portion of Bangladeshi factories employ sustainable methods. The decrease in carbon emissions, waste, and water and energy usage is a single illustration of such a project. Bangladesh is making progress in sustainability, but there remains a lot of room for expansion. Bangladesh's textile and clothing sector faces several significant problems and sustainability constraints, despite its growth potential. One of the most significant issues is the lack of proper training and infrastructure ((Jewel et al., 2022).

Lack of knowledge and understanding is also a challenge to address sustainable innovation. The Bangladeshi government has tried to promote morality and sustainability, but its current budget is insufficient to cover all the country's demands. In addition, many Bangladeshi companies lack the skills and knowledge required to implement sustainability projects successfully (Jewel et al., 2022). The textile industry in Bangladesh faces serious issues with low pay and miserable working conditions. As a result, companies struggle to hire and retain skilled workers, which is necessary for implementing long-term solutions. In addition, many of the manufacturers do not have the approval of international labor unions, which limits their capacity to meet sustainability criteria. One of the many international organizations that strives to maintain worker safety is the Bangladeshi Accord on Fire and Building Security, a legally enforceable pact between multinational corporations and labor unions (Bair et al., 2020). Nevertheless, several non-profit organizations in the area, such as the Bangladesh Environmental Network (BEN), aim to lessen the damaging effects of rubbish, hazardous chemicals, air pollution, and water contamination while also promoting more sustainable lifestyles.

The increasing demand for fast fashion is also challenging to handle for Bangladesh since there is so many small and medium textile producer who utilizes innovation to maximize production efficiency despite thinking about the environmental aspect of it. Bangladesh’s Government also emphasizing to have more green textile producers but without incentives, it’s very hard for small and medium textile producers to implement any of the schemes.

4.6 Textile Industry in Sweden

The history of textile manufacturing in Sweden is extensive and diverse. Iron Age weaving techniques were the first, while hemp has been a component of textiles since the time of the Bronze Age. During the Middle Ages, Sweden had developed into a significant textile manufacturer, mostly of wool and linen but also of hemp and flax. The nation began to focus on producing better wool textiles in the sixteenth century (Kyaga 2017).

The article claims that by the end of the eighteenth century, Sweden had become one of Europe's leading textile manufacturers, producing a range of products including linen, wool, cotton fibers, and silk fibers. The textile industry in Sweden contributed significantly to the country's economy by creating thousands of jobs. The industries promoted the development of new technologies and innovations in the country, including the development of modern weaving

machines. The textile industry in Sweden had substantial expansion after the first half of the twentieth century. Modern procedures like knitting and dyeing have replaced traditional textile production in sectors like the garment industry. As a result, several well-known Swedish textile businesses were unable to thrive on the international market and were eventually forced to shut down.

Sweden has now mainly focused on high-end fashion products instead of massive production. It is often focused on Swedish textile producers to keep the knowledge and the industrial history alive and pass from generation to generation. Also, the industry has close collaboration with educational institutes so that they have all the required knowledge and can preserve it.

4.7 Sustainable Innovation in Sweden's Textile Industry

Sustainable innovation has always been its higher priority in Sweden and that comes from both Sweden and EU regulations to make the environment nicer and fresher for future generations. Sweden's textile sector is becoming environmentally conscious thanks to the development of innovative techniques and technologies that contribute to waste reduction and offer a more ecologically friendly production process. The Swedish Textile Initiative (STI), a government-backed scheme that promotes the production of sustainable textiles, is one of the most noteworthy programs. It has created a set of standards and regulations used in the field of textiles. Utilizing eco-friendly materials like organic cotton, reclaimed polyester, and flax as well as composed of water dyes and eco-friendly finish methods is necessary to achieve this. Along with these efforts, the STI also monitors the textile industry's adherence to ethical labor norms and works to reduce energy consumption and industrial waste (Stål and Jansson 2017).

To become more sustainable, the Swedish textile sector is also adopting other cutting-edge technologies. For example, H&M has created a machine that can recycle and sort items, so minimizing the need for manual labor and minimizing waste. Some businesses have created technologies and materials made of recyclable and recyclable materials to help minimize the quantity of water required for manufacturing.

Second-hand fashion is also very popular in Sweden which allows the country to decrease the over import and take care of resources. Many companies also encourage and establish a closed-loop textile purchasing scheme. Apart from the marketplace, there are also a lot of platforms where customers can easily shop based on their needs but everything in the shop either Store or

online are second-hand. This circularity makes Sweden produce less post-consumer waste which is super important to reduce the effect on the environment.

5 Methodology

5.1 Research Strategy

To conduct the research author set a research design that includes an action plan which specifies the tools and procedures that will be utilized to carry out the study. According to Bell et al. (2019), the research design is that directs the researcher's collection, examination, and interpretation of data which includes the general timeframe for finishing the research project, the research design, data collection procedures, sampling techniques, methods for analyzing the data, and data analysis methodology. We have two ways of the research based on the need, one is Qualitative analysis and Quantitative analysis depending on which could suit best for the report.

Data collection and analysis are part of quantitative research. It helps in determining how frequently a phenomenon happens, how big an occurrence is, and inquiries into the interactions between various components. The research technique known as qualitative evaluation is used to collect and analyze non-numerical data. It is used to examine and comprehend the attitudes, beliefs, actions, and experiences of individuals (Bell and colleagues, 2019). On the other hand, it's crucial to take the topic of research and the kind of data required to provide an answer into account when choosing the sort of study to undertake. Quantitative research is the most effective strategy if the research issue calls for numerical data. If the study issue requires an awareness of people's opinions, beliefs, or values, qualitative research methodologies should be employed.

When discussing concerns with sustainable innovation, qualitative research is a useful source of knowledge. Qualitative techniques enable the creation of full solutions that, as time passes, can lessen the demand for natural resources by illuminating the complexities and subtleties of a problem (Rud'homme et al., 2015). One way that researchers obtain qualitative data on behaviors and attitudes related to various elements of sustainable innovation is through deep conversations, focus groups, findings, and qualitative analysis of content (Cloutier et al., 2020).

Qualitative research may be useful for both the creation of new technological breakthroughs and the discovery of improvements to current systems (Cloutier et al., 2020). Additionally, qualitative research aids in the understanding of how companies overcome various cultural barriers to maintain a sustainable connection with local communities while delivering cutting-edge goods or services. Qualitative research aids in our comprehension of the multifaceted character of sustainability challenges by providing in-depth insights into the interactions among individuals, communities, and organizations (Cloutier et al., 2020).

Qualitative research is essential to the successful completion of this thesis since it may reveal information on the views, values, and behaviors of individuals involved in the industry, such as customers, consumers, and workers. With the utilization of qualitative research, it may be possible to identify the demands and motivations that shape people's choices and actions in connection to environmentally friendly innovation in the textile industry. It can also reveal how people feel about the current sustainability situation in the industry and the sorts of solutions they might be inclined to seek. Qualitative research may help identify the industry's opportunities and challenges as well as potential barriers to sustainable innovation and strategies for overcoming them. Semi-structured interviews may also help researchers. Researchers may benefit from using semi-structured interviews to better understand the challenges and opportunities the firm confronts. Interviews with industry professionals can provide information on the current state of sustainable innovation, the types of technologies being used, the advantages and disadvantages of different approaches, and the potential for development. By interviewing business experts, researchers may learn more about their opinions on sustainable innovation and any potential barriers to progress. This type of knowledge is essential for developing a complete and effective research strategy.

5.2 Research Design

Thematic analysis is one of the qualitative analysis methods used to identify patterns and themes in a set of data. According to Bryman (2012), it is frequently used to evaluate information gathered qualitatively from interviews, focus groups, and open-ended survey questions. Thematic analysis will be used in this project to evaluate a range of qualitative information sources, including interview transcripts, group discussions, and open-ended survey responses. It can help you better grasp the issue by revealing recurring themes and trends in the data. Thematic analysis may be used to derive inferences from the data and pinpoint connections

between various variables. The goal of thematic analysis, as indicated in another article, is to find patterns and themes in a collection of information (Guest et al. 2012). Themes are patterns or ideas that recur in the data and may be used to better understand the content. Thematic analysis is widely used to examine qualitative data from sources including focus groups, interviews, and open-ended survey results.

Since it enables researchers to focus on and delve deeper into the underlying relevance of sustainability-related data, this technique is very beneficial for sustainable innovation in the textile industry. Thematic analysis can help identify opportunities for sustainable innovation by revealing the motivations, attitudes, and beliefs of the stakeholders in the fashion industry (Braun & Clarke, 2006). Using this method, one may also identify impediments to sustainable innovation, including an absence of resources, expertise, or commitment. Theme analysis can help researchers comprehend the factors that limit sustainable development in the textile industry and develop strategies for solving these issues.

5.3 Data Collection

Data gathering through interviews is the practice of directly asking individuals for information through conversation. It is a common practice in qualitative research to collect data using this method, which is a popular way to discover information from subjects. While in-person interviews are the most common, you may also conduct interviews over the phone, through video conference, or online questionnaires. To understand more about the people and the subject at hand, researchers interview the participants. The interviewer may also ask follow-up questions to go further into replies and gain a better understanding of the information provided. It is possible to understand more about people's perspectives, opinions, and experiences by using generally qualitative data from interviews.

5.3.1 Primary Data

According to Bell et al. (2019), the primary source of information is the study's empirical data. The primary technique of data collection for this thesis, which employs a qualitative research methodology, was conducting interviews. The qualitative research strategy uses both unstructured and semi-structured interviews. Unstructured interviews are conversations

involving the individual being interviewed and an interviewee on a particular topic that is more open and unstructured. In that case, a new-in-between interview technique named Semi-structured interviews is introduced to keep a natural flow of the conversation and also to go back to the interview questions from time to time based on the interview.

The concerns and the stated interview question in this thesis lead to the conclusion that a semi-structured interview is adaptable and ensures the best outcome from the interview. The author's predetermined interview guide outlines the specific inquiries arising after the main themes. The semi-structured interview was selected as well because it is predicted that it would allow respondents to interact with those who work in the study's target industry of textile production, improving the validity of data collection. To encourage respondents to share their professional knowledge and abilities on the topic at hand, the semi-structured interview's structure is customizable.

5.3.1.1 Selection of Respondents

The criteria for selecting respondents will depend on the sort of research question, albeit these criteria may alter as the study goes on. As the interview question is specific and clear with an explanation, the easiest way to respond is to apply the approach of deliberate sampling. to familiarize oneself with and acquire a thorough understanding of the adoption of sustainable innovation in Sweden and Bangladesh. The specialists were chosen for their knowledge of sustainability, expertise in the area, and track record of collaborating with diverse businesses to integrate sustainable innovation into their business processes. The experts received a special interview guide to aid them in learning more about environmentally harmful sustainable innovation.

When selecting the companies, the research issue in this thesis and the long-term prospects of the organizations were considered. The respondents were carefully selected to guarantee that they could reply to the research question and had a comprehensive grasp of sustainable innovation. The respondents must be skilled in implementing sustainable innovation inside their businesses or managing sustainability management. To reach potential interview candidates, email or text messages were also used. Since the author has worked in both countries, she may more easily connect with some of the interviewees on an individual level. Interviewees with

prior employment experience in the textile industry or relevant education are chosen to better grasp practical competence.

Respondent	Name	Position	Company	Duration of the Interview	Date	Tools
R1	Jan Franck	CEO	By Willie	60 min	20/04/2023	ZOOM
R2	Rejwan Uddin Shahan	Merchandiser Manager	Utah Fashion Ltd	40 min	15/03/2023	ZOOM
R3	Shaiful Islam	Merchandiser Production	Karooni Knit Composite Ltd	45 min	10/03/2023	ZOOM
R4	Farzana Yesmin	R&D responsible (print)	H&M Supply Chain Bangladesh	35 min	02/04/2023	Teams

Chart: Respondents List

5.3.1.2 Interview Guide

The interview guide is a collection of questions and relevant topics that should be covered throughout the interview process, according to Bell et al. (2019). Based on the semi-structured interview structure, the interview should cover the questions included in the interview questionnaire as well as any extra inquiries the interviewer may have. Themes and interview questions were created using research on dynamic capacities and how they affect the expansion of sustainable innovation. Consequently, the interview queries were developed in line with the collection of secondary data.

In the first portion of the interview guide, the interviewer will identify themselves and provide an overview of the goal and subject of the inquiry. The interviewee then provides a brief overview of his responsibilities and objectives of the business and a strategy for sustainable innovation. The interview will then continue with a discussion of the pre-set (internal and external) questions that might affect the implementation process. The interviewer will then describe the challenges that the firm has faced or is currently facing in implementing sustainable innovation.

Additionally, the interviewee clarifies the distinction between innovative and sustainable innovation. Demonstrated that innovation is the process of creating something new or unique, however sustainable innovation is the process of introducing something innovative or unique

to improve society and the environment. In addition, sustainable innovation prioritizes the long-term implications of the proposed invention while taking all environmental, economic, and social factors into account. We will concentrate on the topics we intended to cover in the interview queries based on issues associated with sustainable innovation, future objectives, and methods for adopting sustainable innovation to lessen its detrimental effects on the environment.

5.3.1.3 Conducting the Interview

The author did 4 interviews to better understand the textile industry in both developed and developing countries. The interview was mostly conducted through Zoom or another video conferencing program because both the interviewee and the interviewees were geographically apart. Every interview will take place in a separate room to prevent distractions throughout the procedure. These forms of interviews are also a simple choice to utilize when there are differences in location and provide several advantages, such as flexible scheduling. Invitations to potential interviews were sent out via emails utilizing email addresses from the internet presence and personal accounts. Once the respondents is ready for the interview, a link to a Zoom or Teams session and a questionnaire guide were provided to them through email. To ensure that the interviewee was ready and knowledgeable about the questions to be asked, the Interview Guide was distributed in advance of and during the interview. Additionally, the candidate receives a reminder three days before the interview to reduce the likelihood of any last-minute cancellations or delays.

Every interview is conducted in English, and it is reflected in the recording. The author also took notes based on the discussion. The interviewer gave a quick self-introduction before going on to describe the goals of the study and what she intended to learn from it. She made the interviewers feel completely at ease and knowledgeable by doing this. Establishing transparency and trust early in the project is also a great tactic. To ensure the accuracy of the data acquisition and for the sake of analysis, the people interviewed were asked to decide if they would agree to have their interview videotaped. Additionally, the recording and hand notes help to avoid losing any important information, especially during the analysis part of the thesis.

5.4 Research Technique

A qualitative research technique is compatible with an inductive methodology, creating new theories or modifying current ones by considering observations and findings, as described by Bell et al. (2019). An inductive technique has some drawbacks that the results of a suggested theory may not be sufficient due to restrictions in the literature. Deductive reasoning, as opposed to inductive reasoning, bases an assumption on a current theory and leads to a modification of the concept. However, the dependence on pre-mature ideas restricts its use of a deductive strategy. So deductive strategy was utilized to acquire existing literature as a foundation for the main data collection, while the inductive approach was employed to connect the conceptual structure to the recommendation from the empirical study. Based on both inductive and deductive approaches the introduction of the abductive technique was raised. Abductive research is used in this thesis to verify the validity of the prior research used for the study of literature and to collect initial information for the empirical findings.

As a comparative study, this research will take information from the primary data source and secondary data sources. All the information will be compared with each other mainly separating between two perspectives one is information from a developed country and information from a developing country. An abductive method will help to verify the information from both countries and come up with suggestions based on the primary information. It will also help us to find a gap between the developed country's sustainable innovation practices and developing countries' sustainable innovation practices and find out the challenges as well.

5.5 Research Quality

Academic research is usually assessed based on its reliability, reproducibility, and validity. However, these criteria' applicability to qualitative research is frequently limited, calling for the development of replacement criteria. Bell and Harley (2019) suggested trustworthiness as an alternative to reliability and validity. A new category termed authenticity has been developed to assess the fairness and importance ramifications of the study. Credibility is a separate concept from internal validity, which emphasizes the dependability of the data collection technique. When research findings are provided to respondents for confirmation, the credibility standards make sure that their interpretations are considered and are produced by best practices. To strengthen the consistency of the data sources and general trustworthiness, numerous sources

of data were utilized in this thesis. To guarantee variety and trustworthiness, both primary and secondary data from diverse sectors were collected.

In place of external validity, transferability assesses the applicability of study findings to diverse contexts. Transferability in qualitative research is challenging to achieve because of the "contextual singularity" of the social setting under study. The utilization of comprehensive narratives of field experiences, like the interviewing process, may result in a portable technique for analyzing results. This thesis includes a detailed description of the primary data collection process to increase transferability. Dependability, which considers whether findings may be applied in many circumstances, is an alternative to reliability. To ensure dependability, it is important to save materials and documents related to participant selection, transcripts of conversations, and statistical analysis decisions. This thesis also addressed issues related to research design and data analysis.

Ensuring that conclusions are unaffected by the researcher's thoughts or interests ensures confirmability, which confers objectivity in business research. Even though it is practically difficult to conduct completely impartial research, it is essential to behave in a trustworthy manner and use tactics and methods that promote objectivity. The inquiries from interviews for the present paper were developed through secondary data gathering and were left free of constraints to prevent outside biases. A follow-up email was sent to interviewers to request their confirmation of the interview summary to boost confirmability.

The key issues with authenticity relate to evaluating fairness, importance, and the political and social implications of the study. To encourage honesty, participants received the interview process guide before the interview. They were better able to understand their roles and the topics they would be discussing when they came as a result. As a result, the researcher's ability to comprehend the varied views of the respondents improved, increasing their level of objectivity. Standard quality standards for commercial research might not apply as well to qualitative research, even though other factors like reliability and authenticity may be useful in assessing the standard of research in different contexts. These criteria have been used in this thesis to ensure that the study is complete and of the highest caliber.

6 Empirical Findings

The author has over 10 years of working experience in the textile industry, and more than half of the time spent working in textile production. So, this helps to interview the experts to engage in the conversation and share knowledge to gather more accurate and updated information. The interviewer has been chosen based on how well they can contribute to this research question.

The interviewee, a sustainability expert in the textile industry, discussed the potential benefits of sustainable innovation in helping the industry lessen its negative environmental impacts. They stressed the need for continued development and pointed out the fact that there continues to be more work to be done, even if progress has been made in areas like water usage, efficiency, and waste reduction. the requirement for innovation in new materials, methods, and technologies that might help reduce the use of resources, including energy and materials, as well as waste creation. The need for cooperation among industry stakeholders and the formulation of appropriate norms and standards were both cited as necessary steps toward achieving sustainability. They also stressed the role of consumers in pushing change, pointing out that the need for environmentally friendly goods is vital for innovation and reducing negative environmental impacts in the textile industry.

6.1 By Willie (Textile Production in Sweden)

Swedish textile producer By Willie is well known for creating eco-friendly clothing. The business was established in 2014, and its main goal is to advocate for organic ingredients in its manufacturing process as well as for its dedication to minimizing waste and energy use. Their main products are textiles for homes and work to preserve the environment. They also produce accessories, and other products that are part of the company's sustainable product range, and they are all made with longevity in mind. By Willie prioritizes openness in its manufacturing processes and supply chains, and they engage with partners and suppliers that are equally dedicated to sustainable business practices. They work on having as less negative environmental impact as possible and practice good ethical business for eco-sustainability.

By Willie not only puts a major emphasis on sustainable production but also design and quality. Their items are made with an emphasis on classic pieces that may be utilized and worn for years in the future. They are both fashionable and practical. It is a business that is devoted established

itself as a pioneer in the manufacturing of sustainable fashion in Sweden thanks to its dedication to organic and renewable resources, transparency, and quality.

6.1.1 Challenges

By Willie has a lot of obstacles to overcome to advance sustainable manufacturing in Sweden, but they are committed to doing so to provide more customers access to eco-friendly clothing. Speaking with R1 about the challenges they are running into when trying to promote sustainable production in Sweden, it became clear that acquiring sustainable materials, particularly for specific product categories, is the biggest problem. Even if the company uses recycled and organic cotton, it might be challenging to find environmentally friendly alternatives for all components. Another challenge comes from manufacturing processes. Scaling up manufacturing while keeping environmentally friendly guidelines is another challenge, but By Willie collaborates with an Enskede-based local manufacturer they know would produce their goods ethically.

"We are more into doing right than becoming big in the market, as we are small, we can do so many things which is hard for big retailers like H&M and IKEA. They are like putting a big ship in the middle of the sea and now trying to move it, so they have a lot more challenges than us"

R1 also mentioned that it's hard to keep the organic material as it is since a lot of buyers' expectation is often to use more chemicals to have a trendier color which does not ensure a positive impact on the environment.

"If we are putting a plastic coating on top of the organic cotton yarn then it's not going to be an organic material anymore, it is very hard to explain to so many buyers"

The fact that consumer demand for sustainable apparel is still a niche market despite greater awareness presents another challenge for By Willie in competing with bigger brands that provide less-priced, less sustainable alternatives. Employing environmentally friendly materials and manufacturing processes could be more expensive.

"So many textile producers offer cheap prices, so the buyers always find their demanded price, so it is very hard to compete with big retailers. But for us, we are not aiming to be bigger and want to educate the buyers and customers to promote more sustainable materials"

The company's CEO also has working experience in India, Bangladesh, and Pakistan and finds it hard to collaborate to have sustainable projects. Most of the business owners have several companies in different locations and do not practice ethical practices for example for taxes and economic contributions. Overall, they are focusing to spread knowledge and education to buyers and consumers to promote sustainability, at the same time doing the right things for the environment despite having all these challenges.

6.1.2 Current Sustainable Practices and Their Future.

The subject of the company's dedication to sustainable manufacture in Sweden was the focus of this conversation with By Willie CEO Jan Franck. The CEO emphasized the value of employing organic and environmentally friendly components in their manufacturing process as well as ongoing attempts to cut back on waste and energy use. The business uses energy from renewable sources to power its manufacturing facilities. The CEO stressed that environmentally friendly manufacturing is a method to ensure high-quality and longer lifespan products to customers as environmental responsibility. The business's emphasis on sustainability has served to set them apart from competitors and draw in environmentally sensitive clients. He gave several illustrations of how they assure sustainability when they negotiate commercial deals.

"*One of our German buyers was having a problem that customers in their store opening the product and it gets messy, so they want me to add plastic wrap on it which is made of 100% recycled material then I have to say no to this since I am against using plastic. The buyer negotiates and tells me that plastic wrap is less costly, but I feel it is more important to stick with my passion and value. Finally, a buyer came back after 2 months saying we understand your concern and we are with you"*

The conversation also covered the costs of investing in sustainable production, including the need for creative waste-reduction strategies and the increased costs of sustainable materials. The CEO expressed hope that ongoing investment in environmentally friendly production methods will eventually pay off for the business and society as a whole. The interview made it clear that By Willie places a high focus on sustainable production and is taking proactive measures to lessen its environmental effect while still offering clients high-quality items.

"I am not up to making money but want to emphasize more towards our Sustainability mission. If we must keep our business small due to huge competition, we don't want to compromise with our values and core belief in sustainability"

By Willie places a constant emphasis on informing its staff and clients about environmentally responsible manufacturing methods and the value of doing so. This aids in developing a sustainable culture both inside and outside the business. It is now collaborating with other organizations to develop more sustainable goods and production methods.

"After 7 years of labor, we were able to make new interior textiles made of 99% recycled material with the assistance of 2 engineers and students. We have some collaboration with other institutions who are helping us to become more sustainable"

Utilizing eco-friendly materials is another smart move. Examples include Tencel, a sustainable wood-based fabric, natural cotton, reused polyester, and recycled polyester. The business intends to further lessen its influence on the environment by utilizing these products. By employing energy-efficient equipment and using renewable energy sources, By Willie also focuses on minimizing the amount of energy used in its manufacturing operations. This aids the business in promoting sustainability and lowering its carbon impact. He also mentioned that Women are more conscious and visionary about sustainability than men in those countries since they have better values and understanding but it's hard for women to drive as the majority of the company has more men in management.

In addition to informing customers about the value of sustainable fashion and looking for methods to make sustainable solutions more available and affordable, By Willie is continuing to place a high priority on sustainability in its sourcing and production procedures. Implementing a closed-loop manufacturing system, which uses recyclable materials, reduces waste, and reuses resources, is one of the excellent practices they employed.

6.2 Karooni Knit Composite Ltd.

The Bangladeshi clothing manufacturer Karooni Knit Composite Ltd (KKCL) specializes in the creation of knitwear. In terms of environmental responsibility, KKCL has put in place several programs meant to lessen its negative effects on the environment and foster social responsibility. A manufacturing facility that complies with all regulations and has sustainable

processes and regulations for the oversight of the supply chain, production procedures, research and development, environmental management, and corporate social responsibility.

6.2.1 Challenges

Clothing manufacturer KKCL encounters several challenges while implementing sustainable production methods. One of the main obstacles for the organization is the cost of environmentally conscious goods and procedures, which are more premium than traditional alternatives. This is a challenge for businesses like KKCL that want to adopt sustainable production methods while maintaining competitive pricing.

"It's very hard to keep up with the buyers' expectations since there are so many textile producers in the country so we know if we don't manage to keep the lower price offer then our business will be in a big risk"

Another challenge is ensuring the application of sustainable techniques throughout the whole supply chain. It is challenging to increase customer demand for sustainable products and to raise knowledge of them, as some consumers might not be willing to pay more for them or may not be aware of their negative environmental impact. Providing clean water for the environment is another significant problem. Having an ETP (a method to clean the water after pollution from utilizing pesticides for coloring and washing textile items) is difficult, especially when maintaining it costs even more money. This is because power is so costly.

"Water is so important for our production and our living. There is no way to count on water, so it is always considered as free but to ensure a safe discharge is very critical."

Government regulations and laws can also affect whether companies like KKCL embrace sustainable manufacturing practices. Although there are numerous regulations, there are also loopholes in the rules. Additionally, they believe that the government should have a regulatory organization to verify that all textile producers are abiding by all laws and regulations. Finally, for sustainable production, new ways of lowering waste, energy usage, and environmental impact are required. The development and implementation of these solutions may be challenging and costly for companies like KKCL.

6.2.2 Current Sustainability and Its Future

The merchandiser stressed the need for innovation and ongoing operation improvement during the interview. This entails looking into emerging markets and product lines as well as engaging in new machines and technology to increase productivity and decrease waste. KKCL has implemented several initiatives to promote sustainability in its business processes. The company has implemented several energy-saving tactics that have resulted in significant energy savings. These tactics include the utilization of solar energy, solar panel installation, and utilization of machine optimization. R2 stated, in their own words:

"We believe that energy efficiency is key to reducing our environmental impact, especially in a country with very limited energy sources and our operating costs, and we are committed to investing in sustainable technologies."

In addition to putting energy-saving strategies into practice, KKCL developed a brand-new wastewater treatment plant to handle and recycle its waste, reducing its water use and environmental impact. The firm will develop a waste disposal system that seeks to reduce garbage and increase recycling as part of its effort to reduce the usage of single-use plastics. The merchandiser also talked about the company's initiatives to provide safe and fair working conditions for its employees. This entails offering their personnel chances for training and development as well as putting policies in place to safeguard worker welfare across their supply chain.

6.3 UTAH Group

A multinational corporation with activities in several industries, including hospitality, real estate, and apparel and textiles, The UTAH Group is located in Bangladesh. Bangladesh's capital city of Dhaka serves as the organization's headquarters. a vertically connected manufacturer seeks to advance Bangladesh by developing a sustainable business strategy that will benefit the nation and the environment.

6.3.1 Challenges

The UTAH Group has a few challenges when it comes to environmentally friendly manufacturing, particularly with how it operates in Bangladesh. It can be difficult to establish accountability and openness across the supply chain when working with several suppliers and

subcontractors. To measure and evaluate the sustainability achievement of its suppliers, The UTAH Group established methods and procedures. The efficiency of resources is another issue because the textile and garment industry is known for using a lot of water and power.

"We have an advanced system to estimate how much waste we are producing, we also have machines to turn in post-production waste, then we prepare recycled fabric. The machines need high maintenance, so we always try to promote recycled fabric to keep the machine running"

Bangladesh has strict rules in place to safeguard employee safety and environmental protection, which presents a challenge for the UTAH Group in terms of compliance. A wide and complicated supply chain makes it more difficult to ensure compliance with these laws. Additionally, using sustainable manufacturing methods can frequently raise manufacturing expenses, which can influence product pricing and customer desire for reasonably priced goods. The UTAH Group likewise faces difficulties balancing the needs of consumers with the requirement to continue using sustainable manufacturing methods.

"We always develop an alternative option to offer buyers and share information with sustainable options and regular options. Sometimes we manage to get a deal with sustainable options if the price difference is not so much. Our R&D team always tries to source from sustainable sources but also negotiate for a better price"

In a field where violations of labor laws are common, it can be challenging to guarantee employees secure and equitable working conditions. The UTAH Group additionally put policies and procedures in place to safeguard employee welfare across their whole business.

"Employee welfare is important for us; we always value our employees' health and wellbeing since most of our workers are female, so we ensure the kids and females food and health"

6.3.2 Current Sustainability Practices and Its Future

The UTAH Group manufactures and exports a broad variety of goods in the textile and apparel industries, such as knitwear, denim clothing, and woven clothing. The corporation has a vast staff of thousands of workers and has multiple industrial sites in Bangladesh. They are known for being a corporation that values environmental preservation and social responsibility. They have put into practice several environmental efforts, such as employing sources of clean energy and consuming less water and energy during production. The business also offers its staff members' families access to healthcare and educational resources.

"*We are very conscious about making a positive impact on the environment and we have goals to be even better in the future. We are working with some international brands and the projects are running connecting with their long-term strategy*"

The UTAH Group operates in the hotel and real estate industries along with the clothing and textile industry. They manage a few resorts and hotel properties in Bangladesh in addition to business and private real estate ventures. It operates in several different areas in Bangladesh and is a sizable corporation. They are renowned for their emphasis on social responsibility and sustainability, as well as for having made a major contribution to Bangladesh's economy and employment.

"*As part of our dedication to sustainability, we have put several strategies into place to lessen our impact on the environment. This entails utilizing renewable energy sources, such as solar panels, and taking action to limit the amount of water and energy used in our manufacturing operations."*

The merchandising manager emphasized the UTAH Group's dedication to minimizing their environmental effect throughout the interview by implementing sustainable production techniques. These methods include the utilization of sources of renewable energy and a decrease in the amount of water and energy used during production.

6.4 H&M Sourcing (Supply chain)

H&M, a global retailer, is renowned for its affordable, often updated clothing. The company works in more than 70 countries and has over 4,500 stores worldwide. Bangladesh is the second biggest sourcing country for H&M, and they are working with more than 300 factories in the country. H&M is also a big retail sourcing company in Bangladesh and very renowned for ethical operation and supplier development in terms of their capability increase. We will investigate H&M primarily from a production and sourcing standpoint in this research. One of the largest sourcing and manufacturing firms in Bangladesh, it has a significant impact on the product supplier. Therefore, it's crucial to look further to comprehend how they might have more of an effect on the provider to help them achieve their major sustainability goals.

6.4.1 Challenges

According to the respondent, the organization deals with issues including expensive raw material costs, significant expenditures in process enhancements, and limited opportunities for

supplier negotiations. By increasing awareness, training suppliers and consumers, driving demand for environmentally friendly procedures and materials, and prioritizing government involvement, the corporation may overcome these difficulties.

"We always make sure to offer fashion to our customers. So, our design focus always comes from the customer's perspective but at the same time, we also keep sustainability in mind. It is very challenging when you also must consider the prices since H&M wants to make affordable fashion for all fashion-loving customers"

Our goal is to increase understanding, educate partners and stakeholders, and drive demand for environmentally friendly procedures even though the firm also confronts difficulties like high raw material costs and implementing process upgrades.

6.4.2 Current Sustainability Practices and its future

By 2030, H&M Group wants to use as many environmentally friendly and sustainable printing techniques as possible. Based on factors including water use, chemical use, energy use, air pollutants, and waste production, the business assesses the effects each printing technology has on the environment, the safety and health of employees, and product end-use hazards. As part of its environmental initiatives, H&M strives to use no harmful chemicals in its goods.

"*H&M Group aims to maximize the usage of low-impact and sustainable printing processes by 2030 and cannot use high-impact printing processes from Order Placement Date, OPD 2025-01-01, in line with the company's strategy towards a circular and climate-positive value chain."*

The respondent indicated that the H&M Group has assessed the hazards associated with the safety and health of employees, product end-use, and environmental implications of its printing operations using the standards of water, chemical substances, energy, air, and waste. The company's sustainability objectives mostly relate to social and environmental issues, such as dangers associated with product end-use and worker safety, as well as the use of resources including water, chemicals, energy, and trash. The respondent also said that their firm is on track with its efforts to employ no harmful chemical discharge in its goods, as well as other sustainability programs like toxic-free fashion. The adoption of sustainable innovations aids in reducing harmful environmental effects in terms of trash, chemicals, air, water, energy, and dangers associated with product end-use.

The respondent thinks that the textile sector is taking measures to make production environmentally safe, such as putting wastewater treatment procedures in place and using chemical checklists to assist in product security and chemical management operations. By applying sustainable practices and technologies, the organization has made measures to minimize many environmental challenges, such as the impact of carbon emissions, contamination of water, disposal of waste, materials handling, and air pollution. Projects like Screened Chemistry, MRSL Compliance, and ZDHC Gateway are examples of sustainable innovation.

6.5 Connection and Correlation between Sweden and Bangladesh

Bangladesh and Sweden share a long history of collaboration in the textile industry. The second-biggest textile exporter in the world, Bangladesh, sells a significant amount of its products to Sweden. The low costs and easy availability of trained labor in Bangladesh, together with Sweden's strong demand for premium-quality textile manufacturing, served as the impetus for this relationship (Globerman and Steven 2000).

According to Stasytyt et al. (2021), Sweden was Bangladesh's third-biggest textile importer of goods, purchasing more than $1.7 billion in textiles. Bangladesh is also one of Sweden's major exporters of textiles, accounting for 10% of Sweden's total garment imports. Over the past few years, commerce connecting Bangladesh and Sweden has steadily increased, with shipments from Bangladesh to Sweden increasing 6.3% from 2017 to 2018. Both Sweden's rising demand for high-end textiles and Bangladesh's affordable labor prices and manpower availability are factors in the country's expansion.

When it comes to lessening the negative effects of the textile sector on the environment, Sweden is well ahead of Bangladesh. Sweden has made a variety of efforts to lessen its impact on the environment, including embracing renewable energy sources, implementing green manufacturing methods, and encouraging the adoption of more environmentally friendly products and industrial processes (Gustafsson and Andersson, 2020). To guarantee that businesses adhere to environmental norms, the Swedish government additionally implemented stringent laws. While the textile business in Bangladesh generally concentrates on cheap, mass-produced apparel, the textile industry in Sweden mostly focuses on high-end, high-quality clothing. Sweden has a highly advanced, complex, and technologically advanced textile sector.

In comparison to Sweden, Bangladesh has fewer environmental regulations, according to a Prothom Alo (2020) study. The government hasn't invested much money in alternative energy sources or green industrial practices. Additionally, there are a lot of uncontrolled companies functioning throughout the country, which increases the pollution of the air and water. As a result, Sweden's textile industry has a much lower environmental effect than Bangladesh's. Bangladesh relies largely on physical labor and has limited access to educational opportunities and technology. Bangladesh has far lower production costs than Sweden, but it is also significantly less productive, resulting in lower-quality items.

In 2018, Sweden produced textiles worth 3.2 billion US dollars altogether, compared with Bangladesh's 28.3 billion US dollars. Bangladesh produces more cloth than Sweden does, by a factor of more than eight. According to the Global Textile Manufacturers Federation, Bangladesh produces 5.2% of the world's textile and clothing, compared to Sweden's 0.4%. Sweden's economy is not as dependent on the textile sector as Bangladesh's. Bangladesh is the second-biggest exporter in the world, accounting for more than 80% of all textile and garment exports (Haque, 2018). The sector, which also provides most of the country's foreign exchange, employs over 4.2 million people (Haque, 2018). Comparatively, Sweden's textile industry is far more modest, with textile and apparel exports making up just 0.3% of its total exports in 2016. 2017 (Statista). This is because Sweden's focus has shifted to other industries, such as technology, which has grown to be a big driver of the country's economic expansion (Kolberg, 2018).

Bangladesh's textile production may emulate Sweden's textile output while retaining its status as a major exporter of textiles. Bangladesh is one of the world's top exporters of textile goods and has an extensive heritage of producing textiles. To preserve its export position, Bangladesh may use the same manufacturing and production techniques as Sweden while adapting them to the local environment (Shareef et al., 2008). This might entail improving production processes, making investments in modern machinery, and ensuring quality control. Bangladesh can exploit its affordable labor force and easy access to raw materials to be competing in the global market. To ensure that any collaboration benefits both sides and that textile employees are treated fairly, understanding between the two countries is necessary.

7 Discussion

According to the interview outcomes, UTAH Group, By Willie, H&M, and Karooni Knit Composite, all place a priority on sustainability in their operations as per their understanding and are transforming sustainable concepts into reality to reduce their adverse environmental impact. Karooni Knit Composite places a high priority on minimizing the usage of water and utilizing renewable energy resources throughout its manufacturing process. The UTAH Group is implementing environmentally friendly alternatives involving solar panels, rainwater collection, and wastewater treatment facilities to decrease its impact on the environment. While Swedish Textile Producers By Willie are more into advanced use of sustainable materials and creating circular business models with morality to push for better sustainability, H&M has a robust sustainability strategy that includes evaluating the environmental impact of their printing processes and maximizing the use of environmentally friendly and sustainable printing techniques.

Sustainable innovation is challenging for all textile suppliers due to several factors including high expenses for raw materials and limited supplier negotiation opportunities to buyers' demand on having cheaper clothes which are connected to less customer demand for sustainable clothing. All interviewers think that awareness campaigns, attitude shifts, and education programs may help address these concerns while also contributing to government assistance for industry encouragement of sustainable methods. Overall, these companies have long-term and short-term sustainable goals as a priority and actively try to reduce their negative environmental consequences but need suggestions and collaboration to speed up on adopting Sustainable innovation to reduce the negative environmental impact.

8 Conclusion

The thesis aims to understand the challenges of Sustainable innovation and how can we adopt Sustainable innovation to reduce negative environmental impact. On the other hand, it also collects primary data through interviews and secondary data through fee searches to analyze some best practices for using sustainable innovation to reduce negative environmental impact. Despite the geographical distance between the textile producers all should follow the same

standard and same morals to practice more environment-positive innovations. Combining the literature review and interview experiences here we put in a summary that is shared here as conclusions.

The sub-question for the main research questions are-

1. What are the common challenges faced by the Textile industry when it comes to sustainable innovation?

2. How can the Textile industry increase using sustainable practices to reduce negative environmental impact?

8.1 Overcoming the Challenges

8.1.1 Findings from Literature

A study by Hodges and Link (2019) examines how design affects innovation in small businesses. Even though the analysis is from developed countries, we can take to the author's claim that design thinking may be a game changer to help anywhere to create and implement novel concepts, goods, and amenities that are consistent with customer needs and preferences. The article discusses several design methodologies and tools that textile firms may employ to foster creativity, such as co-creation with customers, developing prototypes, and environment-friendly design. The articles also stress the need for collaboration and information sharing among countries and textile factories, design establishments, other buyers to collaborate and share information, design establishments, design establishments, and other stakeholders to promote innovation and growth.

Potential application of technology to help achieve sustainability in managing the textile supply chain (Scarsi and Cepolina, 2016). The authors argue that state-of-the-art technology may aid in attempts to solve environmental and social issues, such as reducing the consumption of water and energy, improving worker safety, and supporting moral corporate practices. The article provides a framework that integrates sustainability ideas with supply chain management practices such as product design, sourcing, production, delivery, and end-of-life management. Here it is argued that collaboration between different textile producers, such as designers, vendors, manufacturers, and customers is crucial to achieving environmentally friendly innovation in the clothing industry (Batsaikhan, 2022). The study also described a lot of case

studies of numerous companies that have successfully applied cutting-edge technologies to improve supply chain sustainability.

8.1.2 Findings from the Interview

Bangladesh's textile industry has lately seen several challenges because of a lack of environmentally conscious innovation to decrease adverse environmental consequences. Important industry stakeholders were questioned to gain additional insight into the current situation and potential solutions to address this issue. The results of the interviews show that the biggest issues facing the sector are contamination of water, toxic materials, and energy use. Stakeholders presented a variety of potential solutions to these issues and ways to decrease the negative consequences of the sector. The implementation of green energy projects, the employment of eco-friendly technology, and the creation of waste disposal strategies were all part of these initiatives.

All interviewees highlighted that the sustainable raw material prices are super high, so it is very difficult to meet the buyer’s demand if they want to transfer towards more sustainable materials. Also, for mass production, there is very limited source so very few retailers have access to sustainable materials. Societal practice and the necessary knowledge to operate the business fair and transparent is also another challenge for developing countries. The governments are more focused to gain more money from the textile industry but not so much on encouraging to have sustainability in mind and over the business.

8.2 Adaptation of Sustainable Innovation to Reduce Negative Environmental Impact

8.2.1 Findings from Literature

Potential application of technology to help achieve sustainability in managing the textile supply chain (Scarsi and Cepolina, 2016). The authors argue that state-of-the-art technology may aid in attempts to solve environmental and social issues, such as reducing the consumption of water and energy, improving worker safety, and supporting moral corporate practices. The article provides a framework that integrates sustainability ideas with supply chain management practices such as product design, sourcing, production, delivery, and end-of-life management.

The authors argue that collaboration between different stakeholders, such as designers, vendors, manufacturers, and customers, is crucial to achieving environmentally friendly innovation in the clothing industry. The study also described a lot of case studies of numerous companies that have successfully applied cutting-edge technologies to improve supply chain sustainability.

Additionally, stakeholders recommended that the industry focus on creating incentives for companies to invest in environmentally friendly innovations, increasing consumer understanding of the importance of sustainability, and improving the legal framework for the industry. These techniques might help Bangladesh's textile sector reduce its negative environmental consequences and create a more sustainable future.

8.2.2 Findings from the Interview

The Utah Group is devoted to eco-friendly production techniques, such as utilizing recycled materials and minimizing water use. However, in an extremely competitive sector, the expense of sustainable manufacturing might be a barrier. Small-scale sustainable fashion company By Willie places a high value on ethical production methods and openness. The company also strongly emphasizes strong emphasis on teaching customers about sustainable fashion since they think it can be both accessible and inexpensive. Using environmentally friendly supplies and providing clothes recycling programs are just a couple of the environmental measures that large-scale fashion store H&M has put in place. H&M has nevertheless come under fire for not going far enough to solve problems with labor rights in its supply chain. Karooni Knit Composite, a textile producer in Bangladesh, has implemented sustainable practices such assign place sustainable practices such adopting water-saving technologies and renewable energy sources.

The business has struggled to strike a balance between sustainability and the expectations of the fast fashion sector, which frequently emphasizes low costs above sustainable practices. Transparency, education, and cooperation with customers, including consumers, are stressed as being of utmost significance in advancing toward more environmentally friendly fashion practices.

9 Recommendation

If there is minimal demand, businesses could be hesitant to produce sustainable textile products because they think they won't be lucrative. However, businesses may eventually benefit from creating sustainable products as consumer awareness of and demand for them grows. To increase consumer awareness of sustainable clothing, businesses can employ several marketing strategies. For instance, they may highlight how sustainable clothing benefits society and the environment by reducing carbon emissions, and water usage, and promoting moral labor practices. They may collaborate with organizations and activities that care about sustainability to sell sustainable clothing on social media and through influencers. Some experienced textile producers may provide instructional resources on sustainable fashion, outlining the sources of inspiration and production methods used in sustainability.

Furthermore, environmentally friendly production techniques that minimize waste and contamination are used to create sustainable fabrics. Customers may support businesses that are dedicated to minimizing their environmental effects and promoting sustainability by selecting sustainable fabrics. Therefore, educating consumers about the advantages of purchasing eco-friendly textiles may assist to increase demand for eco-friendly products, motivate businesses to make more eco-friendly products, and eventually help to create a more sustainable future.

Overall, the textile producers need to be morally driven by the understanding that we have only one earth to live in and we should be more mindful to use its resources. Political and government influence may be more focused on creating something for better future generations, they can introduce some ethical course to different textile producers and motive to reduce mass production.

10 Further Research

The shift to environmentally friendly manufacturing and consumption has been most actively pursued by the textile sector, according to the World Bank. The study finds that the industry is steadily making investments in technology that promotes sustainable practices, uses fewer resources such as energy and water, and recycles more materials. According to a World Bank study, industrial collaboration and innovation are essential for attaining sustainable production and consumption. According to the report, the industry is implementing new technologies like 3D printing and material advancements to manufacture goods and materials with higher environmental performance. The importance of industry-government collaboration and public-private partnerships in supporting sustainable innovation may be stressed through further study. It will also be intriguing to watch how emerging technology can be implemented in textile production and create new business models around the supply chain.

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Appendix

Interview Questions

Phase 1

- Would you please briefly introduce yourself?
- What is your current position?
- Can I use your name, current position, and company name in the document? If not pls mention how you would like to be described in the report.

Phase 2

- Does your company have any goal for Sustainability? If yes, then which part (Social/ Environmental/ profitability, etc.) are mostly connected with your company's Sustainable goals?
- Does your company is using/promoting any Sustainable innovation now (if you want you can add examples)?
- Do you think this Sustainable innovation help to reduce negative environmental impact and how (pls share some examples)?
- Any challenges that you/your company faces to implement Sustainable Innovation in textile production now and how we can solve that in the future (you can connect bigger context for ex – governmental rules, consumer choice, or buyer's demand)?

Phase 3

- Do you think the production of textiles now is safe for the environment?
- How do you describe your company's focus on having less negative environmental impact? What steps have you taken to reduce different types of environmental issues (Carbon Footprint, water pollution, waste management, materials resource management, air pollution, etc.)?
- Any example from your organization using sustainable innovation to reduce negative environmental impact?
- Does your company follow any Government rules and external Stakeholder focus to reduce Negative Environmental impact?
- Does your company have assessments by any international organizations to ensure positive environmental impact and how frequently (months/bi-monthly/quarterly etc.)?
- Do you think your company has any plan to focus more on reducing negative environmental impact? If yes, how do you think the goal will be achieved?
- Any challenges now to work more on achieving positive environmental impact?

How can we overcome the challenges?

- What advice would you give to textile producers to reduce negative environmental impact, in your opinion does Sustainable Innovation can help in this context?
- Feel free to add any other questions and comments?

Coding for Challenges

Challenge	By Willie	KKCL	Utah Group	H&M
Cost	Yes	Yes	Yes	Yes
Supply chain transparency	Yes		Yes	
Resource efficiency	Yes	Yes	Yes	Yes
Compliance with regulations		Yes	Yes	Yes
Consumer demand	Yes		Yes	Yes
Labor rights	Yes	Yes	Yes	Yes

Coding for Current Sustainable Practices and its Future

Current Sustainable Practices and its future	By Willie	KKCL	Utah Group	H&M
Cost of sustainable production	2	1	1	3
Supply chain complexity	1	-	2	-
Consumer awareness and demand	2	-	3	3
Regulations	-	4	4	3
Innovation	1	-	-	2
Worker welfare	1	2	5	3
Resource efficiency	1	1	2	3
Compliance with regulations	-	-	3	4

The numbers represent the ranking of the challenge for each company, with 1 being the most common challenge and 5 being the least common challenge. A "-" means that the challenge was not mentioned for that company.