AN INVESTIGATION OF HIGG INDEX EVALUATION TOWARDS THE SUSTAINABLE DEVELOPMENT OF APPAREL INDUSTRY IN BANGLADESH

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AN INVESTIGATION OF HIGG INDEX EVALUATION TOWARDS THE SUSTAINABLE DEVELOPMENT OF APPAREL INDUSTRY IN BANGLADESH

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ABSTRACT

In the past 2 decades, the green supply chain concept or sustainable development in the textile or fashion industry become more important as the brands and people are aware the discarded of the clothes that never worn, and it is contributing the factor of depletion of natural resources and greenhouses gases effect. According to Bank (2019); (Nation, 2019), textile industry has become second most polluted industry come after oil and gas industry around 8% to 10% of the global warming greenhouse effects emissions and including the carbon dioxide and wastewater globally, thus it could cause the ecological impact to environment and human. This issue draws an attention to different stakeholders such as the government agency come out waste prevention activities to promote the sustainable textile and also has proposed the textile industry shall set a consensus standard among manufacturer, supplier to improve the durability of products , and recyclability of the textile products which does not impact on the environment surrounding. Environmentalist practitioners were focused on the education awareness to adopt the sustainable concept & strategies in textile supply chain management. The Higg Index FEM is a set sustainability evaluation tool which is a tool that standardizes and assess the facilities environmental performance by measuring the environment management system, energy usage and GHG emissions, water use , wastewater, air emissions, waste management handling and lastly is chemical management system in the organization to reduce environment impact of supply chain and meet the environmental requirement of industry.

This research project focuses on the Higg Index Facility Environment Module (FEM) created by the Sustainable Apparel Coalition (SAC) to investigate the sustainable development within the textile industry and where the organization utilizes appropriate sustainability management tools like Higg Index FEM 3.0. Moreover, this study aims to investigate and determine most environment impact to the textile between company self-assessment scoring and the assessor scoring. Finally, the self-assessment and external assessment will be compared in terms of their significance and the accuracy with which evaluations are scored. In particular, a comparison study using the secondary data from the Higg Index self-assessment & external assessment data results will be conducted using SPSS Statistics 25 data analysis.

In conclusion, the results of the Higg Index Module were gathered from the organization's assessment and an external assessor; the SPSS statistics results were presented and demonstrated that the score total verified from the external assessor result for the Higg Index's seven components has a significant impact on the Higg Index FEM Scoring, where the skewness and kurtosis normality with (P value more than 0.05). Additionally, the main applicability scores of 0.680 for water and 0.607 for wastewater from the external assessor contribute significantly to the Higg Index FEM Module scoring. Self-assessment scores from the organisation were evaluated to be approximately 33% of the total score or 19.06499 points higher than those from the external assessor.

Keywords: Higg Index FEM v 3.0, Sustainability , SAC, Self- Assessment

[SIASATAN PENILAIAN HIGG KE ARAH PEMBANGUNAN LESTARI INDUSTRI PAKAIAN DI BANGLADESH]

ABSTRAK

(Dalam 2 dekad yang lalu, konsep rantaian bekalan hijau atau pembangunan mampan dalam industri tekstil atau fesyen menjadi lebih penting kerana jenama dan orang ramai sedar pakaian yang tidak pernah dipakai dibuang, dan ia menyumbang kepada faktor kehabisan sumber semula jadi. dan kesan gas rumah hijau. Menurut Bank (2019); (Nation, 2019), industri tekstil telah menjadi industri kedua paling tercemar selepas industri minyak dan gas sekitar 8% hingga 10% daripada pelepasan kesan rumah hijau pemanasan global dan termasuk karbon dioksida dan air sisa di seluruh dunia, justeru ia boleh menyebabkan kesan ekologi kepada alam sekitar dan manusia. Isu ini menarik perhatian kepada pihak berkepentingan yang berbeza seperti agensi kerajaan menjalankan aktiviti pencegahan sisa untuk mempromosikan tekstil lestari dan juga telah mencadangkan industri tekstil hendaklah menetapkan standard konsensus di kalangan pengilang, pembekal untuk meningkatkan ketahanan produk, dan kebolehkitar semula produk. produk tekstil yang tidak memberi kesan kepada alam sekitar. Pengamal alam sekitar memberi tumpuan kepada kesedaran pendidikan untuk menerima pakai konsep & strategi mampan dalam pengurusan rantaian bekalan tekstil. Higg Index FEM ialah set alat penilaian kemampanan yang merupakan alat yang menyeragamkan dan menilai prestasi alam sekitar kemudahan dengan mengukur sistem pengurusan alam sekitar, penggunaan tenaga dan pelepasan GHG, penggunaan air, air sisa, pelepasan udara, pengendalian pengurusan sisa dan akhir sekali ialah bahan kimia. sistem pengurusan dalam organisasi untuk mengurangkan kesan alam sekitar rantaian bekalan dan memenuhi keperluan alam sekitar industri.

Projek penyelidikan ini memberi tumpuan kepada Modul Persekitaran Kemudahan Indeks Higg (FEM) yang dicipta oleh Gabungan Pakaian Lestari (SAC) untuk menyiasat pembangunan mampan dalam industri tekstil dan di mana organisasi menggunakan alat pengurusan kelestarian yang sesuai seperti Higg Index FEM 3.0. Selain itu, kajian ini bertujuan untuk menyiasat dan menentukan kebanyakan kesan persekitaran terhadap tekstil antara pemarkahan penilaian kendiri syarikat dan pemarkahan penilai. Akhir sekali, penilaian kendiri dan penilaian luaran akan dibandingkan dari segi kepentingannya dan ketepatan penilaian dijaringkan. Secara khususnya, kajian perbandingan dengan menggunakan data sekunder daripada hasil data penilaian kendiri & penilaian luaran Indeks Higg akan dijalankan menggunakan analisis data SPSS 25.

Kesimpulannya, keputusan Modul Indeks Higg telah dikumpulkan daripada penilaian organisasi dan penilai luar; keputusan statistik SPSS telah dibentangkan dan menunjukkan bahawa jumlah skor yang disahkan daripada keputusan penilai luaran untuk tujuh komponen Indeks Higg mempunyai kesan yang ketara ke atas Pemarkahan FEM Indeks Higg, di mana kecondongan dan kenormalan kurtosis dengan (nilai P lebih daripada 0.05). Selain itu, skor kebolehgunaan utama 0.680 untuk air dan 0.607 untuk air sisa daripada penilai luaran menyumbang dengan ketara kepada pemarkahan Modul FEM Indeks Higg. Markah penilaian kendiri daripada organisasi dinilai lebih kurang 33% daripada jumlah markah atau 19.06499 mata lebih tinggi daripada markah penilai luar.

Keywords: Higg Index FEM, Sustainability , SAC, Self- Assessment

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CSRD	:	Corporate Sustainability Reporting Directive
EMS	:	Environment Management System
EPR	:	Extended Producer Responsibilities
ESG	:	Environment, Social and Governance
EU	:	Europe Union
FEM	:	Facility Environment Module
GHG	:	Greenhouse gases
GRI	:	Global Reporting Initiative
H_0	:	Normal distribution is taken with a level of significant p
H1	:	Alternative hypothesis
IT	:	Information Technology
K	:	Asymptotic distribution
Ku	:	Kurtosis estimate
LCA	:	Life cycle analysis/assessment
n	:	Number of observations
NGOs	:	Non-Government Organizations
PDCA	:	Plan, Do, Check, Act
REACH	:	Registration, Evaluation, Authorization and Restriction of Chemical Substances
R&D	:	Research & Development
SCM	:	Supply Chain Management
SDGs	:	Sustainable Development Goals
SPSS	:	Statistical Package for the Social Sciences
Sk	:	Skewness estimate

UN	:	United Nation
VOC	:	Volatile of Compounds
χ^2	:	Distribution with two degree of freedom

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CHAPTER 1: INTRODUCTION

1.1 Background

In the past 20 years, the clothing or fashion retail industry has been rapidly growing in emerging countries & developed countries nation. Wang, Liu, Kim, and Kim (2019) have reported that the global apparel & fashion industry total GDP is worth $3 trillion, equivalent to 33 million employment of textile laborers. For example, Nathalie Remy (Oct 2016) states that most of the large emerging countries, such as the Brazil, Mainland China, India, Mexico, and Soviet Union Russia have 8 times faster-growing sales than western countries such as United States, United Kingdom and European Countries. As the consumer expenditure spending increases, the textile industry in emerging economies achieve up to 80% of Western per capita consumption levels, the textile industry's environment impact has also increased, as reported by (Nathalie Remy, Oct 2016) .With the growing population and economic that leads to rapid urbanization, the needs of apparel products have also increased the demands of the raw materials resources such as energy use, water and labor energy to produce the apparels and other accessories. In 2018, UNEP (2017) raised their concerns about the social responsibilities and environment impacts created by the textile industry, warning that if not being properly dealt with, it will escalate the ongoing deterioration and pollution of the environment, which the world is and has already been struggling with. In response to that, countries around the world have started to take aggressive action plans such as promoting effective preventative method and management tools to reduce the current environmental issues. This is a growing attention raised by environment practitioners, focusing on adopting the corporate sustainability & several sustainable strategies in the supply chain management.

The United Nation has launched & adopted the Agenda 2030 that was proposed by UN the Sustainable Development Goals (SDGs) programs back in year 2015. Alongside with the worldwide global taskforce and regional countries, they aim to tackle the environmental issues & to ensure global shifting into sustainable developments for future generations reported by (UCLG, 2015). The goals of the Agenda 2030 primarily focus on the sustainability area such as economic, social and environment.

The apparel industry, which is among the key industries in the world, plays a major part in the sustainable development agenda to tackle environmental issues due to mass production and increasing consumer consumption. In order to mitigate the issues arising from the textile industry, agencies from across the local authorities and regional countries, non-government organizations as well as the some of the well-known fashion companies, have agreed to form a coalition to put on pressure on those textile industries. (Nathalie Remy, Oct 2016). Likewise, Nathalie Remy (Oct 2016) observed that fashion retail store such as the H&M and its competitor like Levi's have cooperated with I:CO company to retrieve those unused fabrics for reuse and reprocessing while I:CO offers the collection containers for them as collection convenience.

The Higg Index FEM V3 is a set of self-assessment scoring measurement standard tools created by the Sustainable Apparel Coalition (SAC) to assess manufacturing facility, brand, and sustainability performance in apparel and footwear accessories in the textile sector. Since the implementation of this tool, it has brought constant improvement throughout the fashion value chains. The SAC was founded in 2009 when Walmart and Patagonia invited other leading global companies to collaborate to develop an index standard that could measure the environmental impact of products manufactured by themselves (SAC, 2020b). The feature of Higg Index FEM consists of module questions designed to evaluate environmental sustainability and impacts by the facility. By conducting these practical qualitative questions, it creates a uniform language for company stakeholders to understand the level of sustainability performance from the company's activities. In addition to that, this tool provides further information for the brands on the impacts on fabric production within the apparel, footwear, and textile industries by taking into the account of the global warming greenhouse effect, energy, water, wastewater/effluent, resources used and chemical. These data assessments can be served as a learning tool for the companies to identify the issues for ongoing improvement and relevant support in decision-making. Furthermore, it allows the user and leaders, regardless of company size, to identify opportunities to improve supply chain management.

This research project aims to identify key priorities of parameters in the FEM module v3.0 towards the reduction of environmental impacts, and to compare and analyze the accuracy of the self-assessment scoring and verifier scoring towards long-term sustainable development impacts to the facility. As the relationship between the applicability question in this latest FEM module and the environmental impacts in textile industry has yet to be analyzed, the research gap for the Higg Index module questions such as self-assessment scoring accuracy of the FEM module between the facility and verifier, will be further investigated in this thesis.

1.2 The Fashion Industry

Over the past two decades ago, the apparel industry has gradually grown with the doubled the production of clothing products volume since 2000 to 2015 and the amount of apparel products globally bought by the worldwide customer has been average increases approximately 60 percent annually were presented by (Nathalie Remy, Oct 2016).

1.3 Environment Sustainability

Environment sustainability is the business owner or the personnel to protect natural resources which is used up and to create alternate point sources of power in the meanwhile to reduce pollution and harmful substance impact to the environment. In the textile industry, the environmental issues come from apparel and garment products has a considerable impact along from the raw material to the disposal of products. Due to this matter arise, environmental tools, industry practices, standard tools have been introduced to guide relevant stakeholders such as designer, manufacturer, suppliers, traders, and consumer to adapting the environmental problem in their work. To accomplish the sustainable development, fashion designer have to get know the potential of environmental impacts and product design incorporated with the environmental friendly elements. Garment products can be easiest transform into sustainable products as the company has control the materials selection, design techniques, processing techniques and able to recyclability reported by (Islam & Khan, 2014).

1.4 Policy Used to Enhance Sustainable in Fashion Industry

The need of bold and decisive policy measures to establish the sustainable fashion as current global using large amounts of non-renewable resources to produce new textile products that always used for a while and discarded as waste. With using national and international policy, it is able to promoting the sustainable concept in textile industry, such as countries like China, Sweden, France as well as the UN and

EU region. These nation and countries established the governing rules, policy and action plan to reduce the social & environmental impact that from textile industry. These developed countries has shown commitment increase collaborate and partnership with NGOs and other stakeholders to support fashion industry. Michiel van Yperen (2020) pointed out the EU countries has detailed an ideal policy and mix strategy to mainstream circular fashion economy with following 5 pillars (innovation policies, incentives, regulation, trade policies, and voluntary action).

A full cycle of the fashion industry which is including the raw material sourcing, design, manufacture, supply chain, retail sales, use and end of life products. Due to this, the supply chain of the fashion companies have restricted the downstream phases of product such as use and end of product life cycle. These regulations to regulate the upstream and downstream stages in supple chain and life cycle of products & process by covering on the waste management, R&D, chemical substances in imported products through regional, global and international legislation framework. (R. F. f. Sustainability, 2013) reported most of the textile related EU legal framework has talk on the issues about import textile products from the low wages countries and set a standards for chemical analysis of textile products such as REACH (Registration, Evaluation, Authorization and Restriction of Chemical Substances).

The REACH legislation was enacted at the regional level by EU countries is to prevent the use of dangerous and hazardous chemicals in the trade market. REACH has the responsibility to ensure that the fashion industry's supply chain adheres to chemical restrictions on imported textile products that contain chemicals. Due to this limitation, developing countries have little desire to practice it as return for economic growth, as well as lack of low encourages and funding from the government to support the existing legislations. Besides that, a revision of Waste Framework Directive were introduced by EU in 2018, separation of textiles based on the waste Fierarchy to rank the end-of-life product with resource efficiency and reduce the environment impact. The preventing waste is the most preferred option, followed by reuse, recycling, recovery and the least will be disposal. The waste hierarchy can be seen in the Figure 1.3.1 as below.

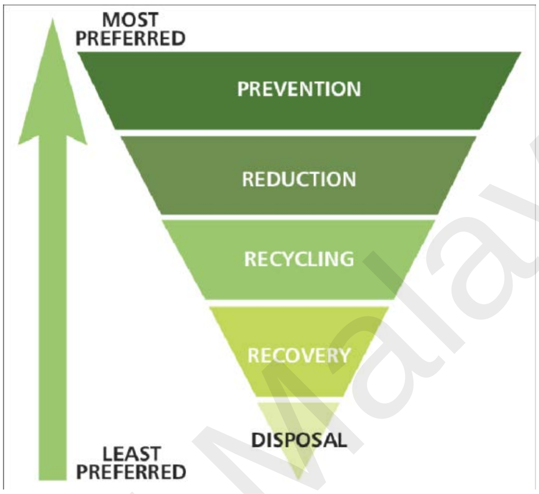


Figure 1.4.1: Waste Hierarchy

Under the revision of Waste directive 2018 approved by the parliament, EU countries required separate collect the textile waste by 2025 and includes action taken to reduce the impact of the textile waste from the production processes and limit the use of the hazardous chemicals on textile products and provide a circular economy for the textile industry reported by (European, 2021). The EU also stated with a sustainable mode of textile production process, it is able boost and stimulate the economy growth and job opportunities and help the consumer to select products with more sustainable in the long run.

At the global level, the UN have launched an initiative with affiliated organizations to promote the United Nations Alliance for Sustainable Fashion with the goal of contributing to the SDGs in the fashion industry. The SGDs which include the social, environmental and economy aspects to be addressed. Members of the United Nations define a policy agenda with recommendations and regional and global objective goals.

According to Alliance (2020), the UN agency work with the Alliance to ensure fashion supply chain met the SGDs targets by promoting the policies and framework set by UN. In addition, the UN has made commitments throughout the cooperation between alliances to minimize the negative effect of environmental and social impacts in the fashion industry and to turn the fashion industry into a driving force for the SDG implementer in order to reduce waste streams, water pollution, GHG emissions, and social impacts. Alliance (2020) reported the fashion industry plays an important role in achieving the SDGs; it represents a trillion dollar industry, which employs over 60 million people worldwide contribute to the economy GDP. Due to their scale and global scope, wasteful activities in the fashion industry have significant impacts on social and environmental indicators. Without any significant improvement in production processes and consumption habits, the social and environmental costs of the industry will continue to increase.

Extended producer accountability (EPR) is another useful instrument technique, with a view to ensuring that manufacturers assume responsibility for the whole life cycle of the goods, taking account of the environmental effects of textile products and the overall supply chain. The extended producer responsibility can be seen as below following figure:

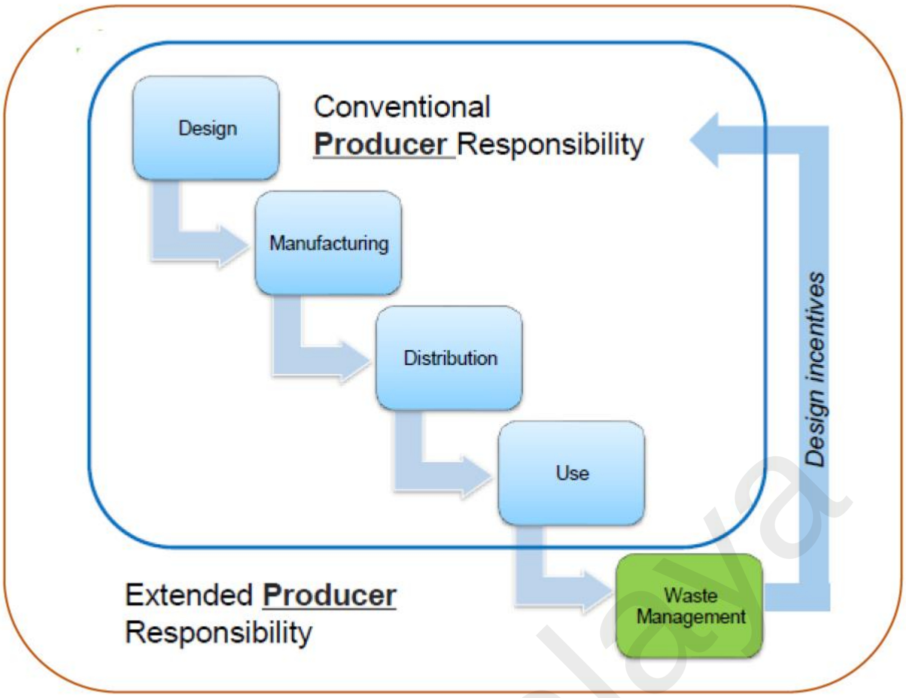


Figure 1.4.2: Flow of Extended Producer Responsibilities (EPR).

This Extended Producer Responsibilities (EPR) definition aims to provide an opportunity for producers to produce more environmentally friendly products that are not harmful to the environment. It also ensures that the manufacturer uses a end of life cycle phase approach to avoid product disposal and then serves as an economic tool to promote more sustainable design and cost savings.

Brussels (2020) noted that EU member states regulated the EPRs in the 2018 Waste Directive, which established minimum standards for establishing EPRs in the textile industry sector to determine their suitability for boosting the circular economy throughout the textile value chain. Furthermore, Brussels (2020) has proposed that an EPR scheme be implemented on textile products to allow the transition of circularity economy and address the possibility of bottlenecks. The circular economy requires collaborations with all stakeholders in which existing obstacles to cycle closure are addressed collaboratively rather than by forcing responsibilities. To that end, the EPR should encourage partnerships to accelerate the flow of information data, develop a common understanding of circular design, facilitate material pooling, remove conflicting laws, and to ensure the demand and supply of recycled materials.

According to Hansson Reuter and Zetterlund (2018) implementing mandatory EPR has resulted in an improvement in the resource productivity of textile products by recycling and reuse, and the only one country in EU region such as French that has implemented the EPR system in fashion industry. With the French model EPR for textiles, it is possible to significantly reduce environmental effects, with results ranging from a 20% reduction in climate change emissions in Sweden to socioeconomic benefits associated with reduced GHG emissions, acidification, eutrophication, and photochemical ozone reported by (Hansson Reuter & Zetterlund, 2018). Furthermore, Remington (2021) reported that the United Kingdom has revealed a textile EPR program scheme for fashion manufacturers that encourages recycling and promotes sustainable innovation in fashion design.

As a result of this, fashion retail firms have pledged to reduce the environmental impact of textile products. Similarity, the EPR helps to solve the environmental issues not only on waste management costs but also on long-term goals in line with the Green Deal and SDGs set by United Nation.

Furthermore, the EU enforces Corporate Sustainability Reporting Directive (CSRD) that require organizations to engage with and be transparent regarding their social and environment sustainability outcomes to their stakeholders, such as end-users, investors, policymakers, and society groups, to assess and enable businesses to adopt more sustainable business practices as reported. It assists the organization in improving its brand through different initiatives and ensuring that the organization recognizes the impacts on sustainability issues.

The proposed Corporate Sustainability Reporting Directive CSRD aims to improve sustainability reporting to exploit the European single market's potential better and contribute to the transition to a fully sustainable and inclusive economic and financial system following the European Green Deal and the United Nations SDGs reported by the (Deloitte, 2021). As a result, the COVID-19 pandemic has fueled the increase in user's information needs, primarily by revealing employees and businesses vulnerabilities and supply value chain.

Following the publication of the proposed new regulations, GRI (2021) has pointed out welcome the European Commission's commitment to improving corporate accountability on sustainability impacts. The CSRD strongly resembles the approach and scope of the GRI Standards, which are now voluntarily used by most major organization in Europe.

1.5 Problem Statement

It is discussed that the sustainable development in the textile or apparel sector drawing major concerns for many stakeholders due to the environment pollution issue. Many organization were using sustainability tools to ensure their manufactured textile products eco friendly to meet the customer green policy and work tactically in the direction to the SGDs.

Many industries, consumer and other related interested parties not aware the existence of Higg Index FEM tools able provide a fundamental evaluation for the sustainability measurement where to measure the company's sustainability performance although many businesses were promoting the green practices on production and awareness concept of the sustainability in textile industry. Moreover, company performance constantly has being conventionally measured with the financial indicators such the price, cost, customer satisfaction percentage level instead of environment factors and it is reported by Alhainen and Järvinen (2015).

Beside that, the feasible and practical to unable make the Higg Index FEM tools to be adoptable in all industries and manufacturer in related field as the standards support the sustainability requirement. Aside from the implementation of the tool in industries, data obtained from the tool is whether meaningful for benchmarking, shared through within related interested of parties and the score result is whether encourage the organization to improve its sustainability.

The readability of the score result which depend on the data gathered by its own member of organization and where the authentication of the score data from the Higg index tool unable to serve as sustainable communication tool or clear message at the product, brands and facility level and it difficult to deliver the same language within consumer, supplier and manufacturer with sustainability score. This is because many other eco-friendly methodology has been exist in the market.

The reliability of the data score in Higg Index FEM Module draw the conclusion of the sustainability score standard and index metrics into the sustainable development . The Higg Index FEM module is relatively new for the non textile industry and therefore the study on the Higg Index module is very limited number reported by (Alhainen & Järvinen, 2015).

1.6 Objectives of Study

To evaluate the significance of impact of Higg Index module FEM 3.0 scoring towards the apparel manufacturing in Bangladesh.

- To investigate the environment impact level of Higg Index FEM scoring among applicability question
- To identify the main applicability in the Higg Index module FEM 3.0
- To associated the significant impact of scoring between self assessment and external assessment.

1.7 Scope and Limitation of Study

The research study has following scope and limitations:

- The study focus on the Higg Index Facility Environment Module version 3.0 with latest version used for study and no other than tools that developed by SAC.
- The secondary data were primarily from country of South Asia, such as Bangladesh. The sustainability assessment were widely used as the growing trade with the exports in the field of textiles and apparel due to the low production cost and as an export hub to the major brands of fashion reported by (Radhakrishnan, 2014).
- The data is limited from the sample data of textile and apparel companies.
- The research study focus on the Higg Index Fem 3.0 evaluation between the self-assessment and external assessment.

CHAPTER 2: LITERATURE REVIEW

2.1 Supply Chain Management (SCM) of Fashion Industry

In the manufacturing operational planning & control point of view, supply chain management can be termed as the management of the movement of products & services activities included on the beginning of process sourcing raw materials, R&D, manufacturing production, warehouse & logistics processes included information system flow to control the activities involved (Handfield, 2020). It can enhance the customer perceptive value and achieve long terms of economic advantages than another competitor through practice sustainable management. The supply chain is combining of the physical and information flow involved every product reached on end-user through multiple organizations. With adopting the cutting-edge IT system, it enables the information sharing integrated all the processes within supply chain management become more efficient and improve communication between supply chain partners and business performance concluded by (Zelbst, Green, Sower, & Baker, 2010).

In 21st century, green practices or sustainable practices apply within the textile supply chain becomes exclusive strategies to setting up the environment sustainable supply chain reported by (Jawaad & Zafar, 2020). Through this sustainable practice strategy, the organization able to compete with other companies and able to achieve the best result in the areas of social, economic, environment and operation activities. Jawaad and Zafar (2020) concluded that green or sustainable practices demonstrated in the supply chain management able to greatly enhance the organization's performance. Results from the study show that eco-design, green distribution and procurement activities are the most significant impact on the organization performance's scorecard. With the putting on practice of the green strategy in SCM, it becomes important tool or strategy to help achieve sustainability & competitive advantage in any industry (V. K. Sharma, Chandna, & Bhardwaj, 2017). To strengthen the sustainability in the textile supply chain, (Li, Zhao, Shi, & Li, 2014) found that influence of the internal stakeholder's commitment able to drive the success towards sustainable development in the textile supply chain. Moreover, it helps organization to build up the reputations in the business world as the environmental concerns are dragging worldwide attention. For example, H&M group is the one the fashion retail work hard and commit to the sustainability within the supply chain, to offer customer environment-friendly apparel product is one of key success of their business strategy (H&M, 2020b). As a result, H&M group has made a positive influence and innovative technology along with their operation from raw materials sourcing to customer value. Moreover, Zeng, Chen, Xiao, and Zhou (2017) revealed that external pressure from the regulatory and NGOs have influences on the organization to ensure they implemented sustainable practices in supply chain management.

2.2 Sustainability Performance

Sustainability can be termed as the ability of the system to focus meet and continue uphold the equilibrium balance of future generations such as the economic, social and environment (Wang et al., 2019).The definition of sustainability according to (EPA, 2016) in order to practice sustainability is to maintain the system where the human and environment coexist and preserve present for future generations.

Meanwhile, sustainable development is the solution to satisfy the essential of the human without jeopardize current present and future generations in order to achieve long term sustainable goals (Emas, 2015). Sustainable development which is included principles framework puts together social, environment and economic into part of the decision making in order towards truly sustainable. Therefore, organizations adopting sustainable management practices in their company due to the internal factor have own corporate responsibility to take initiative towards environment protection (A. Sharma & Narula, 2020). (Shen, 2014) observed the famous fashion business like H&M implemented various sustainable strategies that working across with their suppliers ensure their products sold to the end-user needed to be environment friendly. The sustainable strategy used by H&M such as the online fashion store in certain countries, discounts to customer whoever brings back the used clothing recycle purpose, promote environment-friendly materials, green packaging, awareness program to educate their customer. Furthermore, the H&M fashion retail store is very strict on emphasizing sustainable supply chain to choose their supplier to consider in terms of human welfare, environment, and economics integrated into the business performance scorecards. Recent sustainability report year 2019 published from the H&M group has been unlocking an impressive result compared to the previous year 2018, the group has achieved 97% recycled cotton from the collection, and 57% of recycled materials recycled sustainably reused into new product reported by (H&M, 2020b). Besides, H&M collected a total of 29,005 about 40% tonnes used garments achieving objective goals annually. Other than that, several programs in the year 2020 have introduced by H&M group like zero hazardous waste chemical discharge program in supply chain, climate tackle campaign, and deployment of new innovative recycling technology which 100% produce sustainable materials from recycled materials (H&M, 2020b). It is shown that sustainable development in global textile and fashion industry playing very important roles which can accelerate the goals of the environment sustainable progressing stronger and reduce environment issues. Na and Na (2015) have demonstrated the study using quantitative method show that education awareness about the sustainability of textile can be conducted through the publication materials, using eco-friendly materials, campaign activities and as well as recycled items. Many experts are expecting the apparel product can be made up to 70% from recycled materials in the next few years, it can significantly reduce energy use, carbon emissions, GHG emissions, and other environment pollutions during textile production reported (E. C. R. F. f. Sustainability, 2013; Wire, 2019). Consequently, the textile production depending type of fiber from the apparel as the environment impact of textiles to the environment varies from each other. To, Uisan, Ok, Pleissner, and Lin (2019) have presented a recent global trend in the textile industry to achieve sustainable development & green economy convert textile waste through bio-conversion process to produce value-added products. Turker and Altuntas (2014) reported the total 9 fashion companies in the developing countries, they are concentrating on the sustainability of supply chain issues such as the supplier criteria compliance code of practices, implemented monitoring and audit activities to in order continuously improve their production.

In order tackle 3 major pillars (environment, social, economy) in the SDGs, it is cannot deny that sustainable development is the key solution to maintain the equilibrium balances and moving forward without destroying the needs of future generations. The organization to implement sustainable supply chain management in operation activities, they are usually facing difficulties and challenges to ensure their company operation compliance to relevant parties. Oelze (2017) has using case study pointed out collaboration with external interested of parties are the main issues for the organization to implement this sustainable tool in textile industry during supply chain movement.

Figure 2.2: The 3 pillars (economics , environmental , social) of sustainable development by Kostoska and Kocarev (2019)

Figure 2.1 shows that the sustainability of 3 pillars paradigm (economics, environmental, social) with consists total 17 elements by SGDs were widely practices used in business sector, government bodies, and other organizations.

Figure 2.2: The 17 Goals of sustainable development, United Nation (UN, 2015)

Figure 2,2 shows the 17 Goals of the sustainable development by United Nation.

2.3 TEXTILE ENVIRONMENT ISSUE AND SUSTAINABILITY

Textile industry has been classified as being one of the most polluted industries in the global due to the high consumption of resources like wet processing in production produces large amount of waste chemicals, effluent that can pollute the large scale of water sources. In the textile industry, it is required 2 main raw material like chemicals from dye to transfer agent and as well as the raw water to wash the chemical agents which used in every process and discharged as wastewater which pollutes the environment with effluent, and pH changes after saturated with dyes, and other variety of chemicals used during the production process. Other than that, environmental pollution issues such as air emissions especially VOC compounds and excessive odor or noise occur during the workplace. Thus, sustainable development in textile industries need to maintain in practice on negative impacts of environment and suitable mitigation plans need to be implemented as the sustainable fashion that increasingly used and overused these days make aware of people about the importance of environmental impact of clothes produced by the industry resulting around 10% of GHG emissions yearly reported by (Chan, 2021) . Textile production technology is constantly changing and advance to create a sustainable and improved performance of materials to prevent environment pollution. With these developing technology, able minimize the environment problems like the air, water, environment, global warming issues.

Nowadays, many consumers are keen on green and with social-ethical issues on the sustainability marketed products that align with the values. Fashion designers and manufacturers are facing community pressure to minimize the environmental impact produced by the textile industry with carefully select eco-friendly raw materials and natural resources to ensure continuity of resources for future generation use.

Thus, the manufacturers are starting to adopt the green changes with implement sustainable image in the organization shows to their customer, suppliers and, other stakeholders as environmentally friendly, sustainable element and social ethical image in the product range. At beginning, many organizations have widely used sustainable production with cleaner production concept as the solutions to tackle the environmental problems which to prevent environment disaster in near future with actions like minimize usage of raw materials, using alternative green energy sources, reduce energy consumption in processes, and green packaging material for the products. In order to achieve sustainable concept that set by the SDGs, organization have to follow strictly with the principles such the optimization of resources, social inclusion, value addition, sustainable manufacturing, and the lastly is environment hazards mitigation action that industry must adopt through the new product development, quality and productivity improvement, cost control gradually without affect the competitiveness reported by (Akter, 2019) .However , the organization need to think the appropriate methods to adopt the sustainable practices without the costs associated with harmful to the environment.

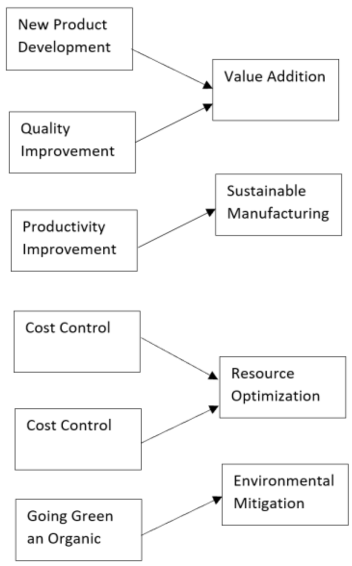


Figure 2.3: Methodology Flow

(Chain') presented that the same approach which is by addressing environmental challenges with a system-wide response can be applied in different industries sectors included the textile industries. This methods connected to the SDGs with focus on the all stakeholders who responsible to the consumption of the resources and sustainable production in manufacturing to produce more sustainable in near future.

2.4 Type of the Management and Tools used in Sustainable Textile Industry

For the company to further their commitment to sustainable growth in near future, a management system or tool is used to measure, assess, manage, evaluate and driven continual improvement within facility such as management system, life cycle assessment and sustainability reporting tool. The systems and tools are described as following:

2.4.1 Environment Management System

An ISO 14001 series framework specifies the requirement of EMS system that enables the organization to enhance its environment performance and systematically apply to the environment aspects factor from of its operation activities, type of products, and services provided to customer. It provides a general framework and guidelines incorporated Plan Do Check Act (PDCA) element approach within the organization effectively manage and to drive the continual improvement company's operational effectiveness. The ISO 14001 structure consists of 10 section where the first 3 sections are introduction and followed by context of organization, commitment of stakeholder & leadership support, operation & planning, resource & support, monitoring & evaluation, and continual improvement. Benefits of adopting ISO 14001 standard in organization, can increase the environment performance and achieve strategic aims with reducing environment issues integrated between suppliers and organization's business systems (ISO, 2015). With the implementation of ISO

14001 EMS system, Zimon and Madzik (2019) reported that its able to enable organization achieve objective targets and able to support and improving the supply chain management within the operation process. The organizations able the find out the benefits of the ISO 14001 standard such as meet and compliance with individual countries regional statutory and regulatory requirements, at the same time increase the leadership engagement in between employees and improve interactions with external parties. ISO 14001 is the recognized international standard that can be adapted within any industries sector regardless of the size, or nature of business which means the organization can use EMS system to modify it based on the company business activities. This EMS standard is the voluntary management system act as the company's supporting tool to improve environment performance at the same time comply with the statutory requirements. However, Darnall (2003) claimed due to the internal capabilities of the organization to adopt the ISO 14001 system able to show improvement in their environment performances during operation activities and manage better environment care. In fact, the company determined to adopt the implementation of ISO 14001 EMS during years of 1994 until 2004 without any pressure influences from interested of parties either internal or external. (Adidas, 2011) claimed its companies awarded and certified with ISO 14001 certification with purpose to reduce environment problems in the own's production site and working toward its company 5 years plan to achieve environment sustainable along with supply value chain. Meanwhile, it is able to boost up the company economy performance and relationship of stakeholders significantly concluded by (Nishitani, 2009). Jawaad and Zafar (2020) have demonstrated that some green practices for the ISO 14001 certified companies adopting the supply chain management great impact to their sustainability development by using mediation analysis and hypothesis testing. For example, the study found that product eco-design method, distribution practices, and green procurement activities have significantly impacted their operation. A study revealed by the author, Campos, de Melo Heizen, Verdinelli, and Cauchick Miguel (2015) indicator frequently used by the ISO 14001 certified company is a legal requirement and environment aspects to monitor their environment performance

In Dec 2018, Charlet (2018) has concluded the survey of certifications for ISO 14001 management system total 171 countries with more than 300,000 company have been certified. In a sentence, it is shown that the interest of the organization toward to EMS gradually increases towards sustainable development.

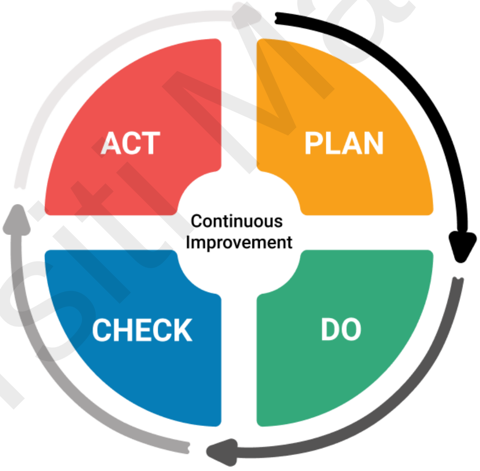


Figure 2.3.1 PDCA (Plan, Do, Check, Act) by (Kanbanize, 2021)

2.4.2 Life Cycle Analysis/Assessment (LCA)

Life cycle analysis is a method where start to end approach also known as cradle to grave technique or tool to evaluate the environment impacts of the operation process activities from the beginning of the stage either in products, services or operation activities until the end of life, use, disposal, and treatment according to ISO 14040 and ISO 14044 standards. The life cycle methodology incorporated with environment management system widely used to manage the sustainability problems that usually in the fabric industry.

Four stage of life cycle assessment can divide into:

- Goal and scope phase
- Inventory phase
- Impact assessment phase
- Interpretation phase

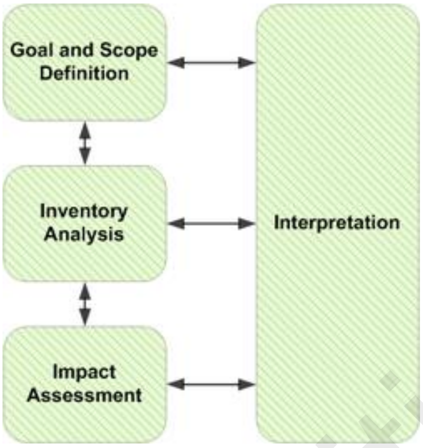


Figure 2.4 General stages of life cycle assessment by ISO 14040

Life cycle tool can offers the quantitative method and, it can easily be applied to define potential opportunities for environment sustainable products (Roos, Posner, Jönsson, & Peters, 2015). Besides, the LCA can act as decision-making tools by providing comprehensive benchmark to the organization to assess the textile products in terms of life cycle perspective. Moreover, van der Velden, Patel, and Vogtländer (2014) revealed the LCA method can be identify the base raw material of textile products which is less impact to the environment after data collected and analyzed included the end-life-cycle .

Besides, life cycle assessment tool known well in environment field as decent tool to evaluate the environment aspects and determine the life cycle of raw materials of the product with additional information such design-related information, process information and as well as environment information that needed by both parties, manufacturer and customer (Cooper & Fava, 2006). Environment practitioners are heavily relying on the LCA tool to collecting questionnaire survey data from inventory phase most time consuming to determine the result from the environment impact, and the complexity of LCA application concluded by the (Cooper & Fava, 2006). Agnhage, Perwuelz, and Behary (2017) have performed the life cycle assessment tools on bio-based dyes by considered their environment impact during the process, and the result show the LCA application approach used has significantly impact by reducing energy use during production and improved the water consumption.

In the previous study conducted by Hansson Reuter and Zetterlund (2018) has pointed out the life cycle assessment tool has been developing into environment LCA, and social LCA.

Environment LCA is used as one of the process approaches to assess, measure and evaluate the product's life cycle in which the outcome will be able bring a great impact to the environment. Some of the factors considered during product life cycle such as energy consumption use, water consumption use, air emissions, GHG emissions related to efficient use of natural resources consumption, climate factor, and eutrophication factor in the environment. With these data collection through LCA application, it can enhance the efficiently usage of resources and improves the production process output significantly.

Social LCA is another approach which assesses, measure, and evaluated the social throughout the product life cycle. However social LCA methods cannot similarity applying different organizations as regardless on the complexity of organization & size of the organization. Through the social LCA, it is intended to develop continuous improvement regarding human health, welfare and dignity. And it is also evaluating the from the perspective of an organization's behavior towards stakeholders, employees, social communities, as well as consumers. Lenzo, Traverso, Salomone, and Ioppolo (2017) revealed the evidence through the research study, with the implementation of social LCA able to enhances the relationship between stakeholders with its employees, inculcate the organization to become more social responsibility towards the communities like H&M group.

2.4.3 Sustainability Reporting

Sustainability reporting is the process of disclosing and communicating a company's environmental, social, and governance (ESG) objectives, as well as its progress toward achieving them.

Sustainability reporting serves as the primary vehicle for conveying the performance and impacts of sustainability. In its simplest form, a sustainability report summarises an organization's environmental and social performance. Organizations can use sustainability reporting to assess their influence on a wide variety of sustainability challenges. Nonetheless, they are critical to the organization's operation and its impacts on communities and their relevant stakeholder's interest. This reporting tool enables stakeholders to understand better the organization's environmental, economic, and social impacts created by its operations. As a result, they can be more forthcoming about the dangers and possibilities they confront. The advantages of sustainability reporting include enhanced corporate reputation, increased consumer confidence, increased innovation, and even better risk management.

To maximize the utility of this information for managers, executives, analysts, shareholders, and other stakeholders. A vital asset is a single standard that enables reports to be rapidly examined, fairly rated, and easily compared. As businesses worldwide have embraced sustainability reporting, the Global Reporting Initiative's (GRI) Sustainability Reporting Framework has been the most commonly adopted, as reported by the (Ecovadis).

The Global Reporting Initiative's (GRI) sustainability reporting principles, were established in collaboration with a wide range of stakeholders, appear to be the most commonly recognized and influential among company businesses worldwide . The GRI guidelines are intended to establish a generic framework for organizations and stakeholders to communicate about economics, the environment, and social issues.

According to Hansson Reuter and Zetterlund (2018) sustainability reporting could be a method for an organization to report and communicate with all relevant stakeholders by publishing a sustainability report. Although the EU directive does not have to report based on the requirement of the international standards, many organizations based in EU region are reporting based on the GRI standard which is a global standard for the sustainability reporting.

For example, World (2020) has reported that Huntsman Corp, a chemical manufacturer, has published the corporate sustainability report, which aligns with the UN Sustainable Development Goals & UN Global Compacts' initiative report their organization progress towards environmental, social and governance performance to their stakeholders. This initiative will enable the organization to go beyond the basic standards set by GRI requirements.

Thus, a sustainability report can reflect the company environment & social performance level. Sustainability reporting has become common practice for the organization nowadays. The benefit of the sustainability reporting such as the company's commitment and their transparency towards to the social and environment enable the end-user confidence to purchase their textile products. Additionally, these practices can assist a business in enhancing its reputation image and brand value for the items it offers by meeting the demands and expectations of important stakeholders and employees. With the collection of data on industrial processes and their influence on the environment, this data can assist businesses in increasing resource efficiency by lowering natural resource use and waste, as well as improving operational performance were reported by (Uddin, 2017).

(World, 2021) has mentioned with the sustainability reporting it can create ethically and sustainable products that able to offer creative solutions to the end-user, external supplier, employees, public and important stakeholders. While encouraging new conversations and collaborations, this sustainability report also increases accountability as the organization tries to make a positive influence on the planet that will last for generations by chemical industry company, Milliken & Company.

(H&M, 2020a) discussed about in the sustainability report about H&M group committed to increase the transparency and strategies plan and also the environmental credentials of their products to assist our customers in making better educated purchasing decisions. Besides that, it can establish a positive transformation to the fashion industry by building relationship with customer offering with more sustainable products and circular business models. With the current initiative, it is capable of achieving sustainable growth that benefits both people and the environment.

Gbolarumi, Wong, and Olohunde (2021) has reported that the sustainability assessment on processes, that conducted in the apparel industry where it shows that assessment results with consider SGD three pillars able to enhance the internal &

external decisions of users and aid users and decision makers in their internal and external judgments on the sustainability and competitiveness of textile industry plants through a well-detailed assessment. Esendemirli Saygili, Saygili, and Gören Yargı (2019) has reported the around 18% of textile and apparel companies in the Turkey provide sustainability assessment disclosure about the water and effluents and shows that the company has made a commitment to the sustainability and environment compliance practices.

CHAPTER 3: LITERATURE REVIEW

3.1 The Sustainable Apparel Coalition (SAC) Higg Index FEM 3.0

This chapter aims to explain the function of the Higg Index FEM module 3.0 and its related sustainability performance of the textile supply chain.

The Higg Index is a standardized evaluation tool for the sustainability supply chain developed by the Sustainable Apparel Coalition, a non-governmental organization comprised of a group of fashion companies, and the United States Environmental Protection Agency (EPA). It includes various assessment tools used to evaluate and assess an organization's social and environmental impact, including the Higg FEM Module.

The application of the Higg Index FEM to evaluate and assess an organization's sustainability impact on seven factors (water, wastewater, waste management, EMS, greenhouse gas emissions/energy, chemical use, and air emissions) to find and promote opportunities for development by (SAC, 2020a). With the use of the tools, it provides a clear view for the textile manufacturer understand and measure the environment impact that created from the processes and create a common language engagement with all relevant stakeholders discussed by (Tangne, 2013). Thus, the Higgs index is intended to support businesses by identifying and quantifying sustainability consequences, decreasing redundancy in assessing sustainability; reducing risk and uncovering efficiency; and serving as a standard method of communication with stakeholders.

3.1.1 Higg Index FEM Module 3.0

In the following ways, the Higg FEM adds value and insight, such as where the FEM is a yearly evaluation of an apparel facility's environmental management capabilities, methods, and strategies. This data is most frequently self-reported by a manufacturer and to be shared with any buyer who requests it through the Higg Index platform to calculate the total score from the module. Also, it provides the questions according to the organization needs & requirements to result in better data and more transparency in the supply chain.

The Higg Index EM module consists of the 7 sections with primary & secondary questions with levels 1, 2 and 3. Primary questions are number based and the secondary question can be listed as below (Higg, 2020):

- Select (Yes/No)
- Multichoice
- Enter text
- Enter number
- Upload with document files

The Higg Index scoring system was created to drive behaviour change and to reflect actual picture of the environment performance used in the facility (Tangne, 2013). The Higg Index is intended to assist retailers, suppliers, and manufacturers in improving their facilities' internal and external sustainability performance.

In each section of the Higg Index FEM consists of 3 levels of structure questions

- Level 1- Tracking and awareness
- Level 2- Baseline and improve Performance
- Level 3- Practice through innovations

In the FEM module, the organization must unlock and meet the level 1 questions before moving to the level 2 & level 3 questions. When the level 1 was not complete, or the organizations' practice could not meet the level 1 question's requirement; levels 2 and 3 cannot be continued by the organization. This is ensure the fundamental practices are well established by the facility or organizations before moving on the advanced practices level 2 and 3 are assessed. The Higg Index assessment converts each metric update into a score point to assess the sustainability of the standard baseline. In each of the impact area consists of 3 levels structure question which total of 100 points and where each section equally portion (14.3%) of the score point assigned to the Higg FEM score.

EMS	Energy/GHG	Water	Waste	Wastewater	Air Emissions	Chemical Management
100%	100%	100%	100%	100%	100%	100%
100%						
14.30%	14.30%	14.30%	14.30%	14.30%	14.30%	14.30%

Figure 2.5 : Shows that the score points allocation in each sections.

In each question, the point will be earned based on the answer by the facility/assessor to each question:

- For answer "yes", will receive full points.
- For answer "partial yes", will received half points
- For answer "no or unknown", will receive zero.

The length of time it takes to finish the Higg FEM depends on how much of the relevant data and information has previously been gathered before beginning the module. Facilities will typically need take 2-4 weeks to complete the entire module, including time for internal debates and evaluation. Before beginning, facilities should study all of the questions in the module to acquire a better understanding of the type of information and data they will need to enter the data into the module.

The table below shows the general structure of the applicability questions from the 7 sections

Table 3.1.1.1: General Structure of Higg Index FEM Module v 3.0 Question

Facility Information and Permits	Question Level
EMS	Level 1
	Level 2
	Level 3
Energy & GHG	Level 1
	Level 2
	Level 3
Water Use	Level 1
	Level 2
	Level 3
Air Emissions	Level 1
	Level 2
	Level 3
Waste	Level 1
	Level 2
	Level 3
Chemical Managements	Level 1
	Level 2
	Level 3
Wastewater	Level 1

	Level 2
	Level 3

CHAPTER 4: RESEARCH METHODOLOGY

4.1 Problem Discussion

This research demonstrates the 7 most significant dimensions factor of sustainability impact where the data have been gathered from external assessor.

In this research study, in order to investigate the significance of sustainable development in the fashion towards to the stakeholders with the Higg Index FEM scoring evaluation, the research hypothesis as follows:

1. The environment impact level which influence of the Higg Index scoring.
2. Among of the 7 dimension factors in the main applicability affect the the scoring of the sustainability scoring
3. Relationship between level weight and applicability in each section influenced the sustainability scoring.
4. Significant of influence of the scoring between self-assessment and external assessment has determine the Higg Index scoring.

4.2 Theoretical Framework of References

According to discussion on the chapter 1 and literature review about the correlation between both dependent variable and independent variable affect on the sustainability impact index scoring. Figure 3.1 shown the conceptual framework between independent and dependent variable

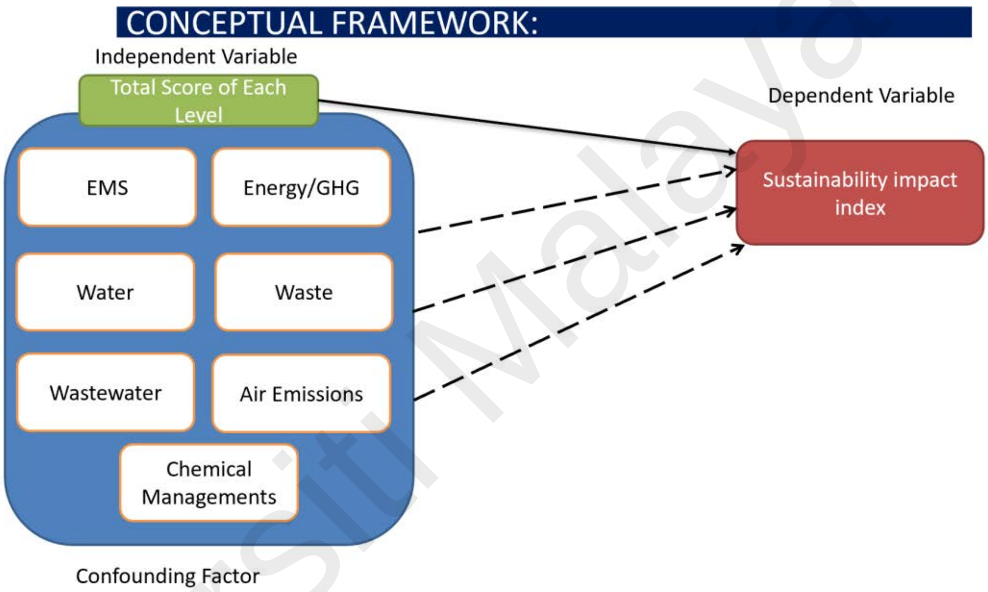


Figure 4.2 Conceptual Framework

4.3 Methodology

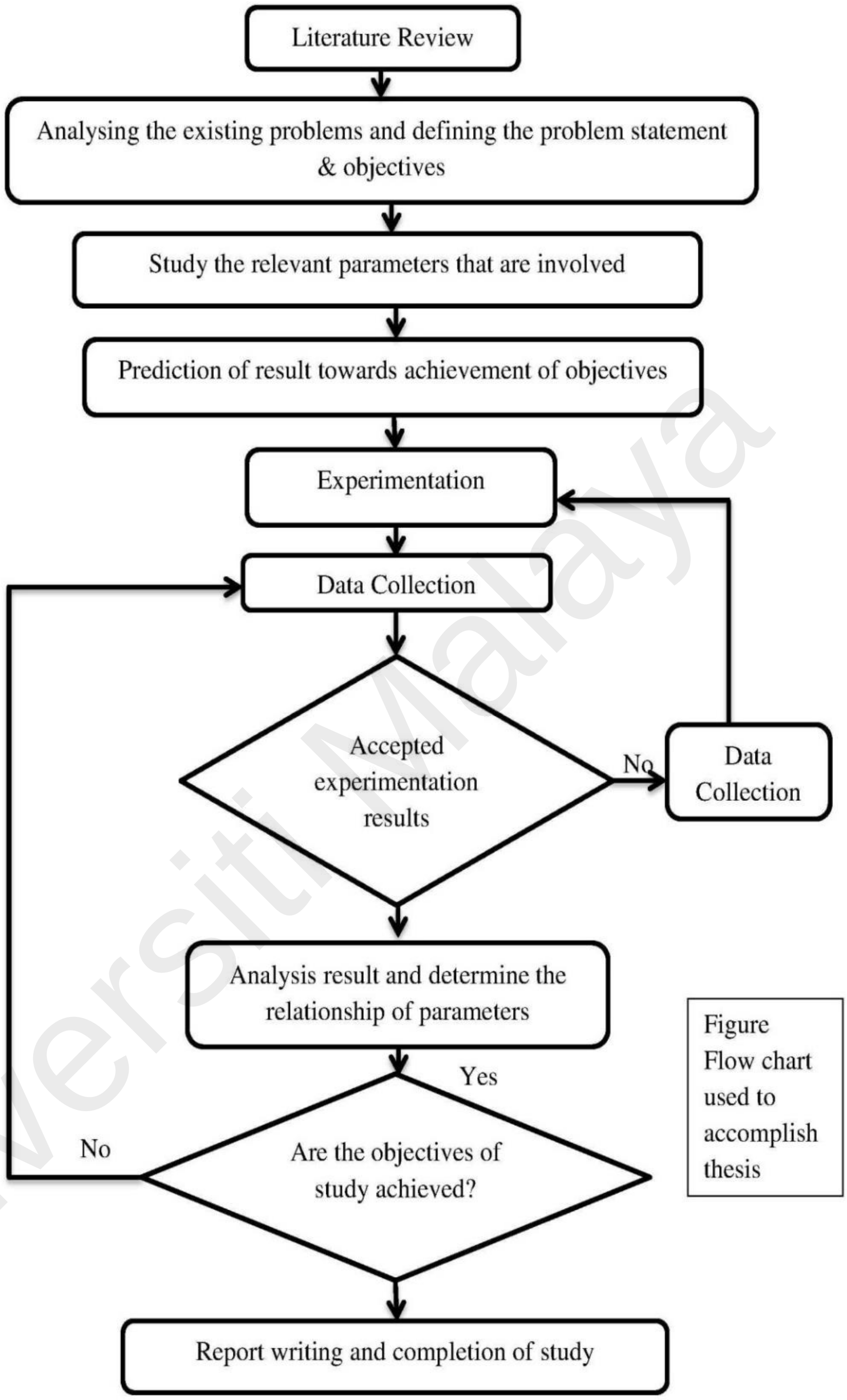


Figure 4.3: Methodology Flow

4.4 Research Methodology

This chapter will discuss the research approach that used & adopted on this research topic. This chapter will discuss every aspect of conducting this research, including the research strategy , research methods, research approach, number of population size in the research design, , selection of the sample, and research process. The methodology flow were described in the figure 4.3 started with literature review, analyze, study the experiment, prediction of result, experimentation, data collection, result analysis, and report writing and completion of study.

Finally, the chosen mode of analysis and data gathering method are described in dept in this chapter.

4.5 Research Strategy

In this research strategy, the secondary data were gather from the questionnaire were quantitative/ to measure or identify the relationship between the dependent variable and independent variable from among the 7 factors of Higg Index, which contributes to the impact of the Higg Index FEM module scoring.. The questionnaire were obtained from the Higg Index Portals (Higg Index) where to gather the data from the raw materials to finish end products, which consists of the 7 key factor influence the environmental impact performance scoring to the organization.

4.6 Research Settings

The experimental settings were conducted at textile companies in Bangladesh country by using the Higg Index FEM Module question which done through online (Higg Index) or offline method with excel spreadsheet tool as shown as below.

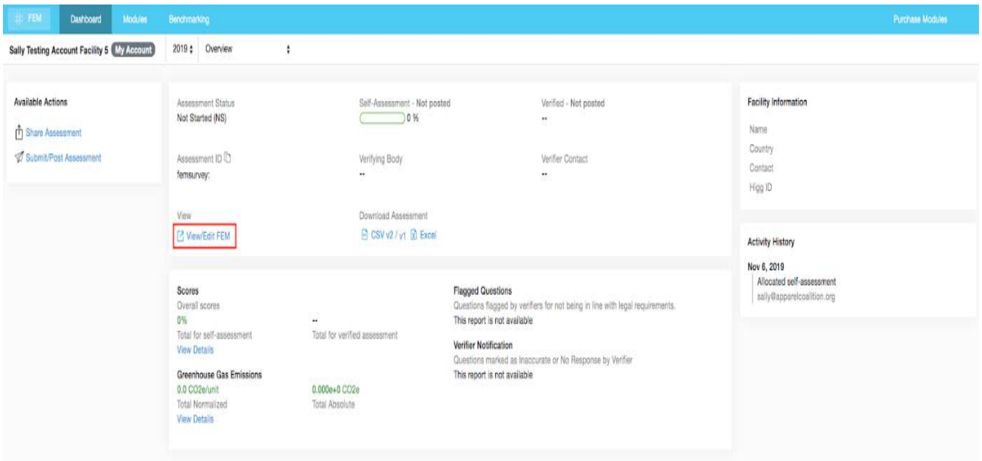


Figure 4.6: Higg FEM Homepage (SAC, 2020a)

Figure 4.7: The Higg Index FEM Module tool with offline method. (SAC, 2020a)

Total 23 companies in textile industry sector were filtered from the data collection through the self assessment and external assessment will be used in the experiment. The self assessments for Higg Index FEM module need to be done by the facility organization before the external assessment could be carry out.

4.7 Research Approach - Qualitative versus Quantitative Technique

Qualitative research is verbal in nature. It is used to comprehend concepts, ideas, and experiences. This type of research enables researcher to gain in-depth insights into poorly understood subjects.

Qualitative methods include open-ended interviews, verbal descriptions of observations, and literature reviews that delve into concepts and theories. The primary characteristic of qualitative research is that it is best suited for small samples and that its outcomes are not measurable or quantifiable because it provides a thorough description and analysis of a research topic without limiting the scope of the study.

However, the effectiveness of qualitative research is heavily dependent on the skills and abilities of the researchers, and the results may not be perceived as reliable because they are based on the researcher's personal judgments and interpretations. Because it is more appropriate for small samples, it is also risky for qualitative research results to be interpreted as reflecting the opinions of a larger population.

Quantitative research is characterized by the use of numbers and graphs. It is used to verify or disprove theories and hypotheses. This type of research can be used to establish a topic's generalizable facts. Experiments, observations recorded as numbers, and surveys with closed-ended questions are all examples of common quantitative methods discussed by (Streefkerk, 2021).

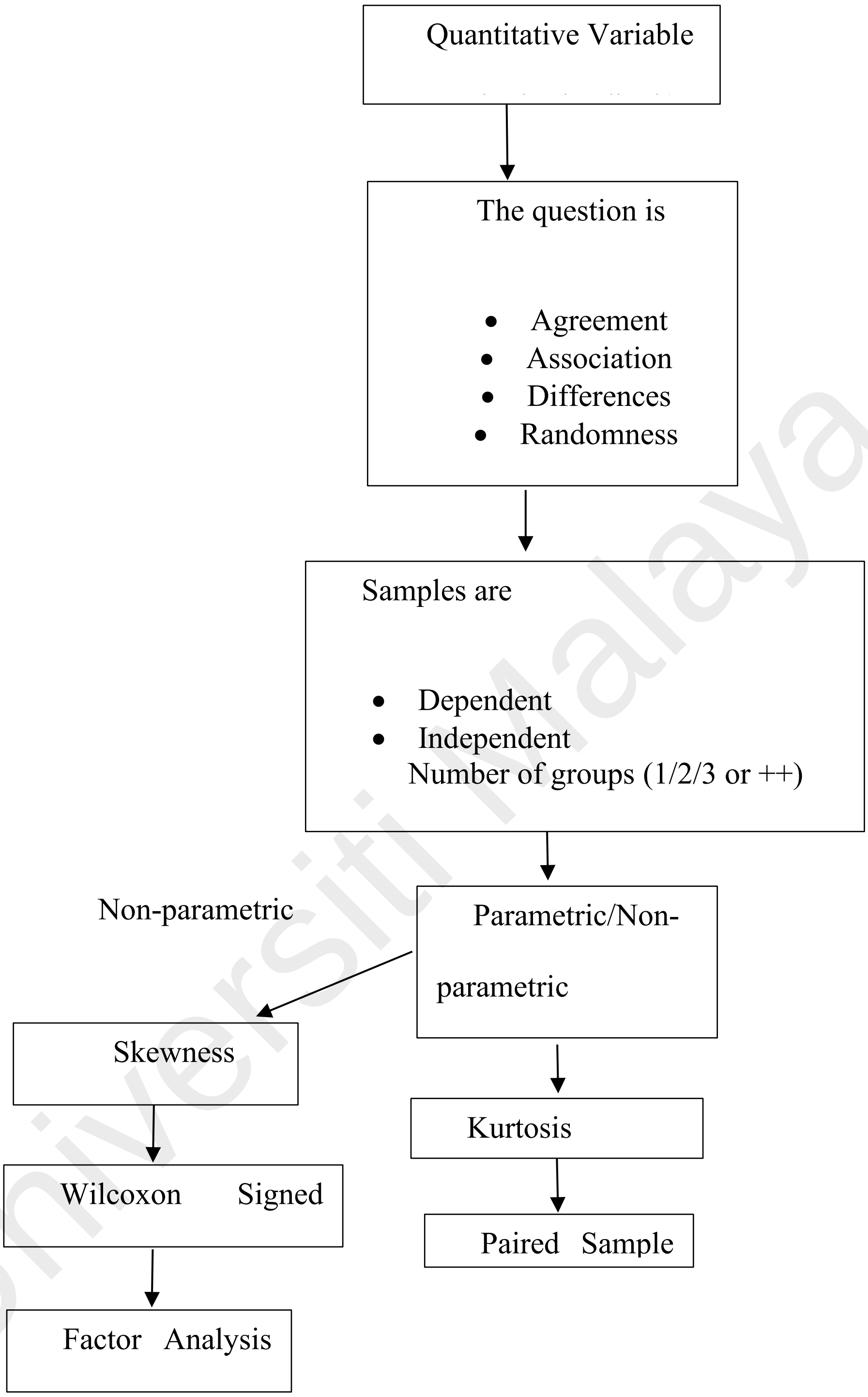
Table as shown below between quantitative and qualitative research.

Table 4.7: quantitative and qualitative research.(Streefkerk, 2021)

Quantitative research	Qualitative Research
Focuses on testing theories and hypotheses	Focuses on exploring ideas and formulating a theory or hypothesis
Analyzed through math and statistical analysis	Analyzed by summarizing, categorizing and interpreting
Mainly expressed in numbers, graphs and tables	Mainly expressed in words
Requires many respondents	Requires few respondents
Closed (multiple choice) questions	Open-ended questions
Key terms: testing, measurement, objectivity, replicability	Key terms: understanding, context, complexity, subjectivity

Experimental study has been conducted using quantitative experimental methods, with the method focusing on the relevant parameters that determine the affect the sustainability development performance in the textile industry. The data collection for the quantitative methods describe as following below in the analysis flow chart

Analysis Flow Chart



As shown from the analysis flow chart, the secondary data were used and collected from the organization and the external assessor, the data were quantitative data where the question is agreement, association, differences, and randomness. The samples with number of group more than 3, is then to determine whether parametric or non parametric.

Parametric tests are those that make assumptions about how the population is distributed when the sample is taken from it. This is frequently the case when the population statistics are assumed to be regularly distributed. Non-parametric tests are "distribution-free" and can thus be used for variables that are not normally distributed.

As results, non parametric data will go for the Wilcoxon signed and finally the factorial analysis to determine the relationship of the dependent and independent variable.

Parametric data will under go statistic of the kurtosis and pair sample T test data analysis to carry out the experimental analysis using SPSS

4.8 Data Collection

4.8.1 Data Collection Technique

There are two approaches to data collection and analysis: qualitative and quantitative, with a focus on numbers. Quantitative is frequently used interchangeably with any technique for data collection (such as a questionnaire) or data analysis (such as graphs or statistics) that generates or uses numerical data. In the meanwhile, qualitative technique is to generate non numerical data.

Secondary data were collected from the Higg Index FEM Module and verified against the facility's Higg FEM module. Some of the quality parameters were identified to carry the research study, these parameters were measured and analyzed using statistical analysis. As a result, a quantitative technique was chosen for this survey.

All the data collected were through on field collection by verify document information obtained from the organization. Total 34 textile company were collected and verified on field and after filtered and refined , 23 sample size were chosen for the experiment study of their relationship of dependent and independent variables. The sample of the questionnaire can be found in the following appendix.

4.8.2 Sample Selection

This study discus the sample subject in the Bangladesh which majority in the textile industry, they can be large companies or SME organization. Activity areas of these organization related to the textile industry and related supply chains. Several organizations can be included in this category, but those who involved and related in textile industry can considered in this research study.

CHAPTER 5: RESULTS AND DISCUSSION

As a component of the research technique, data analysis is one of the phases of defining, evaluating, and testing the research questions and hypotheses, allowing us to draw some conclusions about the study topic.

Data analysis would be run with according the steps: Descriptive statistics (Skewness and Kurtosis Normality), Paired Sample T-Test, Wilcoxon Signed Rank Test, and Factor Analysis (KMO and Barlett's Test).

5.1 Results of SPSS

Skewness and Kurtosis Normality

Skewness is a measure of symmetry, specifically the absence of symmetry. Asymmetric distribution or data set looks the same to the left and right of the centre point.

Kurtosis determines whether the data are heavy-tailed or light-tailed compared to a normal distribution. Data sets with a high kurtosis have a high proportion of outliers. Low kurtosis data sets have light tails or a lack of outliers. The most extreme case would be a uniform distribution.

Table 5.1: Cases Processing Summary of Data (Table Continued)

Case Processing Summary

	Cases					
	Valid		Missing		Total	
		Percent	N	Percent		Percent
Score Total	2	100.0%	0	0.0%	2	100.0%
Score total verified	2	100.0%	0	0.0%	2	100.0%

Water Score	2	100.0%	0	0.0%	2	100.0%
Water.score.verified	2	100.0%	0	0.0%	2	100.0%
Air Score	2	100.0%	0	0.0%	2	100.0%
Air.score.verified	2	100.0%	0	0.0%	2	100.0%
Wastewater Score	2	100.0%	0	0.0%	2	100.0%
Wastewater.score.verified	2	100.0%	0	0.0%	2	100.0%
Chemical Score	2	100.0%	0	0.0%	2	100.0%
Chemicals.score.verified	2	100.0%	0	0.0%	2	100.0%
Ems Score	2	100.0%	0	0.0%	2	100.0%
Ems.score.verified	2	100.0%	0	0.0%	2	100.0%
Energy Score	2	100.0%	0	0.0%	2	100.0%
Energy.score.verified	2	100.0%	0	0.0%	2	100.0%
Waste Score	2	100.0%	0	0.0%	2	100.0%
Waste.score.verified	2	100.0%	0	0.0%	2	100.0%

Most SPSS procedures display information about valid/missing values at the very beginning of their output; this typically means that will need to scroll up the viewer to the very beginning of the process output to find that information.

The case processing summary were generated from the IBM SPSS statistics results in table 5.1, and it is concluded that there is no missing data input value in the beginning of the SPSS. It also advised that the data analysis be carried out and it is shown that the both data collected from the organization and external assessor data were not missing with total 22 ,total 100% valid percentage will shown 0%, if there is missing data from the SPSS for the analyzed, it “the column of the reflect on “N, cases missing” with number of data not presented in the SPSS statistic 25. In conclusion, table 5.1 were shown all data presented without any data missing, and can proceed for the statistics analyzed.

Descriptives

Descriptive statistics are short descriptive coefficients that summarize a given data set, which can represent the entire population or a sample of the population. For example, measures of central tendency and variability are two types of descriptive statistics (spread) reported by (Hayes, 2021).The mean, median, and mode are examples of measures of central tendency, whereas standard deviation, variance, minimum and maximum variables, kurtosis, and skewness are examples of measures of variability.

Table 5.2 Data Results of Skewness and Kurtosis for 7 parameters as well as the standard errors associated with them. (Table Continued)
Summary of Skewness & Kurtosis Results

Table 5.2:Summary of the SPSS result output extracted only the skewness and kurtosis to be considered from the table 5.2, and the skewness and kurtosis results were tabulated as below

	Skewness	Kurtosis
Score Total	0.294	-0.619
Score Total Verified	-0.071	0.186
Water Score	-2.094	4.797
Water score verified	-1.112	0.706
Air scorV	1.894	3.565

Air Score Verified	0.95	-0.805
Waste Water Score	-0.62	-1.806
Wastewater Score Verified	-0.413	-1.614
Chemical Score	0.563	9.206
Chemical Score Verified	2.277	9.206
EMS Score	-0.1842	2.121
EMS Score Verified	2.366	4.871
Energy Score	-2.4	6.861
Energy Score Verified	-1.733	4.262
Waste Score	0.425	-1.081
Waste Score Verified	1.615	2.282

The table 5.2 shown that the summary of the results skewness and kurtosis where the yellow highlighted were deemed to the normal the as is p-value more than 0.02 resulted from the skewness and kurtosis analysis.

To be deemed normal in SPSS, the skewness and kurtosis statistic values must be less than 1.0. If the value is larger than + 1.0 for skewness, the distribution is right skewed. If less than -1.0, the distribution remains skewed.

If the value of kurtosis exceeds + 1.0, the distribution is leptokurtic. The distribution is platykurtic if the value is less than -1

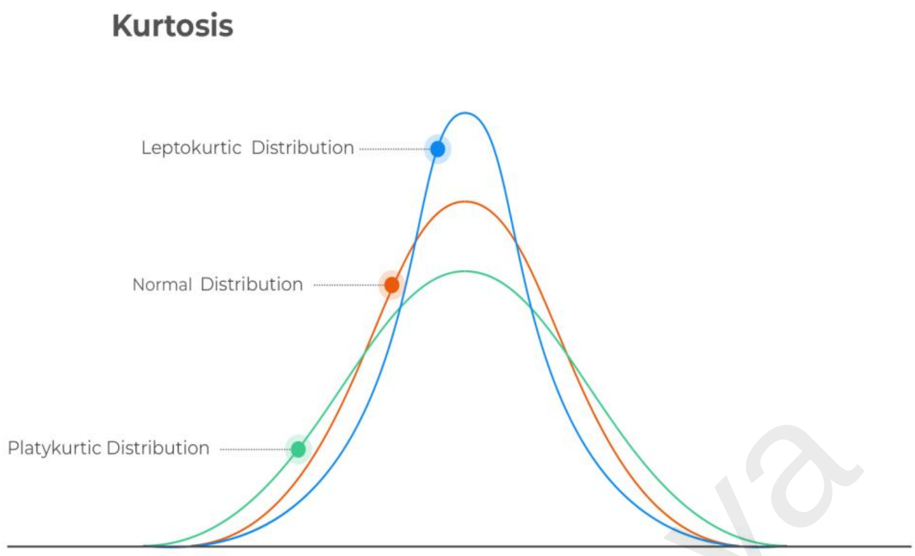


Figure 5.1 Categorization of Normal, Leptokurtic, Platykurtic distribution by (Prep, 2019)

The skewness and kurtosis were consider the value

$$K = \frac{n}{6} Sk^2 + \frac{n}{24} Ku^2$$

where n is the number of observations, Sk is a skewness estimate, Ku is a kurtosis estimate.

The value K has an asymptotic distribution χ^2 distribution with two degrees of freedom.

The hypothesis H_0 about the normal distribution of observations is taken with a level of significance p if

$$K < \chi_p^2.$$

The result from the table 4.3 were shown that the following parameter were deemed the normal data distribution such as score total with skewness, 0.294, kurtosis -0.619 were normal; score total verified skewness -0.071 kurtosis 0.186, Waste water score skewness -0.62, kurtosis value -1.806; chemical score skewness 0.563, kurtosis 9.206, EMS score and finally the waste score skewness 0.425 kurtosis -1.081. Other parameter were not normal distribution as the skewness value were more than + 1.0 of the value.

5.3 Test of Normality

Table 5.3 Results of the Test of Normality for the 7 parameters from the Higg Index FEM Module

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Score Total	.134	22	.200*	.953	22	.369
Score total verified	.129	22	.200*	.958	22	.451
Water Score	.314	22	.000	.664	22	.000
Water.score.verified	.207	22	.015	.880	22	.012
Air Score	.285	22	.000	.769	22	.000
Air.score.verified	.164	22	.126	.925	22	.097
Wastewater Score	.237	22	.002	.872	22	.009
Wastewater.score.verified	.264	22	.000	.766	22	.000
Chemical Score	.333	22	.000	.781	22	.000

Chemicals.score.verified	.203	22	.019	.768	22	.000
Ems Score	.344	22	.000	.655	22	.000
Ems.score.verified	.439	22	.000	.601	22	.000
Energy Score	.276	22	.000	.697	22	.000
Energy.score.verified	.171	22	.095	.837	22	.002
Waste Score	.171	22	.093	.929	22	.115
Waste.score.verified	.268	22	.000	.809	22	.001

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

The normality of data is required for many statistical tests, as normal data is a premise of parametric testing. Normality can be determined in two ways: graph presentation and number value. Table 5.3 were shown that all the data present result and from the results the significance where p value > 0.05, score total & score total verified, 0.2 were normality distributed.

The Kolmogorov–Smirnov one-sample test determines whether or not two sets of values agree. The two sets of values evaluated for this purpose are an observed frequency distribution based on a randomly collected sample and an empirical frequency distribution based on the population of the sample. When the empirical frequency distribution is based on a normal distribution, the observed sample is also checked for normality.

The Kolmogorov–Smirnov one-sample test is used to compare the cumulative frequency distributions of two random variables. A cumulative frequency distribution helps determine the number of observations in a data sample greater than or equal to a specific value. It is calculated by adding all of the preceding frequencies in the list to a specific frequency. In other words, it's analogous to keeping track of the frequencies inside a distribution. The most significant will determine from divergence between these two distributions by constructing cumulative frequency distributions of the observed and empirical frequency distributions. The test then utilizes the most significant divergence to calculate a two-tailed probability estimate p to evaluate whether the samples are statistically similar or dissimilar.

According to Minitab (2019), the p-value is compared to the significance level to determine whether the data do not follow a normal distribution. Typically, a significance threshold (abbreviated as or alpha) of 0.05 is sufficient. A significance level of 0.05 suggests that the probability of incorrectly concluding that the data do not follow a normal distribution is 5%. For example, for the p-value as follow

P-value $\leq \alpha$: The data are not normally distributed (Reject H0)

If the p-value is less than or equal to the significance level, the null hypothesis is rejected, indicating that the data do not follow a normal distribution. The data suppose intend to analyze data that does not follow a normal distribution, verify the analysis's data requirements. While certain studies may operate with non-normal data, others may require data transformation or the use of a different methodology.

P-value > α: It is impossible to determine that the data do not follow a normal distribution (Fail to reject H0)

If the p-value is greater than the significance level. In that case, the null hypothesis is not rejected since there is insufficient evidence to conclude that the data do not follow a normal distribution. You cannot, however, deduce that the data have a normal distribution.

Null Hypothesis, H0: the data follow the normal distribution

Alternative hypothesis H1: the data reject the hypothesis

From the result of the test of normality table 5.3 , it is shown that significant level which is more than zero, the score total with p-value 0.200, score total verified with p-value 0.200, waste with p-value 0.093 , water energy score verified with p-value 0.095, air score with p-value 0.126, are significant where the p-value are positive and normal.

Pair test T test is test on the normality value for the score total & score total verified as the is normally distributed where the significance value (more than 0.05) and where the rest of 7 parameters (self reported & external assessor) were compared using the non parametric samples (Wilcoxon Signed Rank Test).

5.4 Paired Samples T Test.

According to the Berg (2021), a paired samples t-test is mathematically equivalent to the one-sample t-test on difference scores. As a result, it makes the two assumptions listed below.

- Independent observations;
- Normality: the difference scores in the population must be normally distributed. Normality is only required for small sample sizes of N 25 or less.
- There were no outliers in the difference between the two groups.
- The difference in paired values follows a normal distribution (approximately).

Table 5.4.1 Results of Mean and Standard Deviation of Pair Samples Statistics

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Score Total	57.3170	22	11.44211	2.43947
	Score total verified	38.2520	22	12.58807	2.68379

Table 5.4.2 Results of Pair Samples Correlation

Paired Samples Correlations

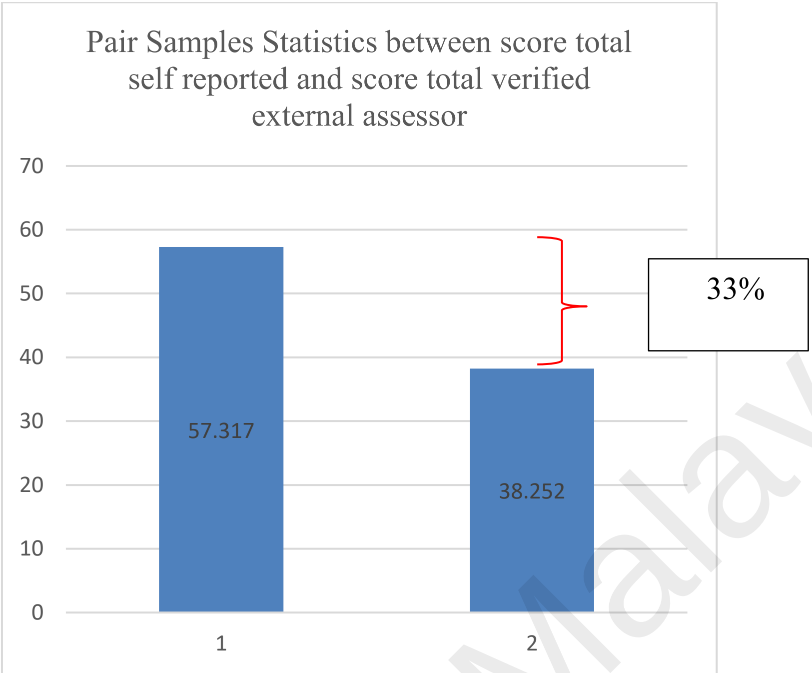
		N	Correlation	Sig.
Pair 1	Score Total & Score total verified	22	.651	.001

Paired Samples Test

Table 5.5 Result of Pair Samples Test Differences

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Score Total - Score total verified	19.06499	10.09848	2.15300	14.58758	23.54240	8.855	21	.000

Graph 1: Different of percentage of self reported/assessment and external assessor



According to the results data in table 5.5, the p-value normal is greater than 0.05 for score total and score total verified, so the paired sample T test was used to determine the difference between self assessment and external assessor's results. The results of the table 5.4.1 Pair Samples statistics showed that the mean with 57.317 score total from the self assessment was much higher than 38.252 for the score total verified from the external assessor's result with number of samples taken, implying that the self assessment from the organization was evaluated the Higg Index value was more than 33% different compared to the external assessor. This demonstrates that the self-evaluation result from the facility or organization evaluated themselves higher than the external assessor and the external assessor score total verified result.

From the table 5.5 Pair Samples Test, t test statistic result is 8.855 , p-value is less than 0.001and it was shown have significant difference between the self assessment/ reported and external assessor

From the table 5.4.2, the pair sample correlations results shown that the self assessment score total and external assessor score total verified results are significantly positively correlated (r =0.651).

5.5 Non parametric test – Related samples (Wilcoxon matched-pair-rank)

Wilcoxon Signed Ranks Test

When one or more of the Paired Samples t Test's assumptions are violated, that may to conduct the non-parametric Wilcoxon Signed-Ranks Test instead.

Water Score

Table 5.5.1 able shows the Wilcoxon Signed Rank Output for Water Score & Water Score Verified.

Test Statistics

Ranks

		N	Mean Rank	Sum of Ranks
Water.score.verified - Water Score	Negative Ranks	17[a]	9.00	153.00
	Positive Ranks	0[b]	.00	.00
	Ties	5[c]		
	Total	22		

a. Water.score.verified < Water Score
b. Water.score.verified > Water Score
c. Water.score.verified = Water Score

Test Statistics[a]

	water.score.verified - Water Score
Z	-3.667[b]
Asymp. Sig. (2-tailed)	.000

Exact Sig. (2-tailed)	.000
Exact Sig. (1-tailed)	.000
Point Probability	.000

a. Wilcoxon Signed Ranks Test
b. Based on positive ranks.

From the statistics Asymp. Sign (2 Tailed) p-value is .000 and the z-value is -3.66, mean rank is 9.0, the approximate p-value is lied on the standards normal distribution and it is significant normal. The waster score verified is more favorably than waster score.

<u>Air Score</u>

Table 5.5.2 Table shows the Wilcoxon Signed Rank Output For Air Score & Air Score Verified

Ranks

		N	Mean Rank	Sum of Ranks
Air.score.verified - Air Score	Negative Ranks	11[a]	6.68	73.50
	Positive Ranks	1[b]	4.50	4.50
	Ties	10[c]		
	Total	22		

a. Air.Score.verified < Air Score
b. Air.Score.verified > Air Score
c. Air.Score.verified = Air Score

Test Statistics[a]

	Air.score.verified - Air Score
Z	-2.712[b]
Asymp. Sig. (2-tailed)	.007
Exact Sig. (2-tailed)	.004
Exact Sig. (1-tailed)	.002
Point Probability	.000

From the statistics Asymp. Sign (2 Tailed) p-value is .007 and the z-value is -2.712, mean rank is 6.68, the approximate p-value is slightly lied on the standards normal distribution and it is less significant difference. The air score verified is slightly favorably than air score.

<u>Waste Score</u>

Table 5.5.3 Table shows the Wilcoxon Signed Rank Output for Wastewater Score & Wastewater Score Verified

Ranks

		N	Mean Rank	Sum of Ranks
Wastewater.score.verified - Wastewater Score	Negative Ranks	11[a]	6.73	74.00
	Positive Ranks	2[b]	8.50	17.00
	Ties	9[c]		
	Total	22		

a. Wastewater.score.verified < Wastewater Score
b. Wastewater.score.verified > Wastewater Score
c. Wastewater.score.verified = Wastewater Score

Test Statistics[a]

	wastewater.score.verified - Wastewater Score
Z	-2.027[b]
Asymp. Sig. (2-tailed)	.043
Exact Sig. (2-tailed)	.046
Exact Sig. (1-tailed)	.023
Point Probability	.004

a. Wilcoxon Signed Ranks Test
b. Based on positive ranks.

From the statistics Asymp. Sign (2 Tailed) p-value is .043 and the z-value is -2.027, mean rank is 6.73, the approximate p-value is not on the standards normal distribution and it is not significant normal. The wastewater score verified is slightly less favorably than wastewater score.

Chemical

Table 5.5.4 Table shows the Wilcoxon Signed Rank Output For Chemicals Score & Chemicals Score Verified

Ranks

		N	Mean Rank	Sum of Ranks
Chemicals.score.verified - Chemical Score	Negative Ranks	22[a]	11.50	253.00
	Positive Ranks	0[b]	.00	.00
	Ties	0[c]		
	Total	22		

a. Chemicals.Score.verified < Chemical Score
b. Chemicals.Score.verified > Chemical Score
c. Chemicals.Score.verified = Chemical Score

Test Statistics[a]

	Chemical Score.verified - Chemical Score
Z	-4.108[b]
Asymp. Sig. (2-tailed)	.000
Exact Sig. (2-tailed)	.000
Exact Sig. (1-tailed)	.000
Point Probability	.000

From the statistics Asymp. Sign (2 Tailed) p-value is .00 and the z-value is -4.108, mean rank is 11.50, the approximate p-value is lied on the standards normal distribution and it is significant. The chemical score verified is more favorably than chemical score

EMS

Table 5.5.5 Table shows the Wilcoxon Signed Rank Output For EMS Score & EMS Verified

Ranks

		N	Mean Rank	Sum of Ranks
EMS.score.verified - Ems Score	Negative Ranks	18[a]	10.47	188.50
	Positive Ranks	1[b]	1.50	1.50
	Ties	3[c]		
	Total	22		

a. Ems.Score.verified < Ems Score
b. Ems.Score.verified > Ems Score
c. Ems.Score.verified = Ems Score

Test Statistics[a]

	EMS.score.verified – EMS Score
Z	-3.777[b]
Asymp. Sig. (2-tailed)	.000
Exact Sig. (2-tailed)	.000
Exact Sig. (1-tailed)	.000
Point Probability	.000

From the statistics Asymp. Sign (2 Tailed) p-value is .00 and the z-value is -3.777, mean rank is10.47, the approximate p-value is lied on the standards normal distribution and it is significant. The EMS score verified is more favorably than EMS scor

Energy

Table 5.5.6 Table shows the Wilcoxon Signed Rank Output For Energy Score & Energy Score Verified

Ranks

		N	Mean Rank	Sum of Ranks
Energy.Score.verified - Energy Score	Negative Ranks	9[a]	5.00	45.00
	Positive Ranks	0[b]	.00	.00
	Ties	13[c]		
	Total	22		

a. Energy.score.verified < Energy Score
b. Energy.score.verified > Energy Score
c. Energy.score.verified = Energy Score

Test Statisticsa

	Energy score.verified - Energy Score
Z	-2.680[b]
Asymp. Sig. (2-tailed)	.007
Exact Sig. (2-tailed)	.004
Exact Sig. (1-tailed)	.002
Point Probability	.002

From the statistics Asymp. Sign (2 Tailed) p-value is .007 and the z-value is -2.680, mean rank is 5.00, the approximate p-value is slightly lied on the standards normal distribution and it is less significant normal. The energy score verified is favorably than energy score

<u>Waste</u>

Table 5.5.7 Table shows the Wilcoxon Signed Rank Output for Waste Score & Waste Score Verified

Ranks

		N	Mean Rank	Sum of Ranks
Waste.Score.verified - Waste Score	Negative Ranks	19[a]	10.00	190.00
	Positive Ranks	0[b]	.00	.00
	Ties	3[c]		
	Total	22		

a. Waste.score.verified < Waste Score
b. Waste.score.verified > Waste Score
c. Waste.score.verified = Waste Score

Test Statistics[a]

	Waste Score.Verified – Waste Score
Z	-4.108^{b}
Asymp. Sig. (2-tailed)	.000
Exact Sig. (2-tailed)	.000
Exact Sig. (1-tailed)	.000
Point Probability	.000

From the statistics Asymp. Sign (2 Tailed) p-value is .000 and the z-value is -4.108, mean rank is10.0, the approximate p-value is lied on the standards normal distribution and it is significant normal.

5.6 Factor Analysis

Factor analysis is a statistical technique to explore variable that observed, correlated variable with a set of underlying variable . This is accomplished by looking for unobservable (latent) variables that are reflected in observed variables (manifest variables). A factor analysis can be conducted in various ways (such as principal axis factor, maximum likelihood, generalized least squares, unweighted least squares). Additionally, numerous rotations can be performed following factor extraction, including orthogonal processes such as varimax and equinox, which restrict that the factors cannot be correlated, and oblique rotations such as Promax, which allow the factors to be associated.

Score Total (Self reported/ assessment)

Table 5.6.1 SPSS Output 1

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.411
Bartlett's Test of Sphericity	Approx. Chi-Square	37.407
	df	21
	Sig.	.015

Table 5.6.2 SPSS Output 2

Communalities

	Initial	Extraction
Water Score	1.000	.247
Air Score	1.000	.515
Wastewater Score	1.000	.163
Chemical Score	1.000	.179
Ems Score	1.000	.106
Energy Score	1.000	.261
Waste Score	1.000	.650

Extraction Method: Principal Component Analysis.

From the table 5.6.1, SPSS output 1, significant P value is 0.015 whereby the KMO and Barlett's test measure the test of the null hypothesis with the original correlation matrix the factor analysis is inappropriate as p is 0.015 ($p<0.05$) were imply that the variable correlated between the variables. And the KMO value must (>0.6) , waste score with value 0.65 is most sufficient contributing factor from table 5.6.2.

Table 5.6.3 SPSS Output 3

Component Matrix[a]

	Component 1
Waste Score	.807
Air Score	.717
Energy Score	.511
Water Score	.497
Chemical Score	.423
Wastewater Score	.404
Ems Score	.326

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

From this table 5.6.3 SPSS Output 3 , it is shown that the score total (self reported/assessment by the organization) , the most contributed significant factor from waste score 0.807 , air score 0.717, energy score 0.511, water score 0.497, chemical score 0.423, and EMS score 0.326.

Score total verified (External Assessor)

Table 5.6.4 SPSS Output 4

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.636
Bartlett's Test of Sphericity	Approx. Chi-Square	58.153
	df	21
	Sig.	.000

From the table 5.6.4 SPSS output 1, significant P value is 0.000 whereby the KMO and Barlett's test measure the test of the null hypothesis with the original correlation matrix the factor analysis is appropriate as p is 0.00 (p<0.05) indicated that the variable were significantly correlated. And the KMO value must (>0.6) , waste score with value 0.807 is most sufficient contributing factor following by the air score with 0.717 and finally energy score with 0.511.

Table 5.6.5 SPSS Output 5

Communalities

	Initial	Extraction
water.score.verified	1.000	.680
air.score.verified	1.000	.025
wastewater.score.verified	1.000	.607
chemicals.score.verified	1.000	.284
ems.score.verified	1.000	.489
energy.score.verified	1.000	.523
waste.score.verified	1.000	.576

Extraction Method: Principal Component Analysis.

Table 5.6.6 SPSS Output 6

Component Matrix[a]

	Component
	1
water.score.verified	.825
wastewater.score.verified	.779
waste.score.verified	.759

energy.score.verified	.723
ems.score.verified	.700
chemicals.score.verified	.533
air.score.verified	.159

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

In comparison to table 5.6.4 SPSS Output 4, table 5.6.6 Output 6 the external assessor score total verified shows that the most significant impact is water score verified, 0.825, wastewater score verified 0.779, waste score verified 0.759, energy score 0.723, EMS score verified 0.700, chemical score verified 0.533, and air score verified 0.159.

The descriptive statistics are used to determine the normality of the data, the number of samples taken from both the organization's self-assessment results and the external assessment results, which are collected and assessed on the field to represent the actual system implementation in the company. Skewness and kurtosis were calculated using the SPSS results, and it was found that data with a normal distribution of graph and a p-value greater than 0.02 resulted from the skewness and kurtosis analysis, for example score total with skewness, 0.294, kurtosis -0.619 were normal; score total verified skewness -0.071 kurtosis 0.186, Waste water score skewness -0.62, kurtosis value -1.806; chemical score skewness 0.563, kurtosis 9.206, EMS score and finally the waste score skewness 0.425 kurtosis -1.081 as yellow highlighted.

Other parameter which not normal distributed is water score, water score verified, air score, air score verified, wastewater verified, chemical score verified, EMS score verified, energy score verified and waste score verified. It is proven the parameter collected from both the organization self assessment and external assessment from third party, the data is not consistent on the center of graph. From the table 5.2, both score total & score total verified of the 7 parameters , the data p-value is more than 0.02 , the skewness and kurtosis is normal distributed.

As the score total & score total verified data is normal distributed, paired samples test statistics carry out the experiment. From the table 5.4.1, result of mean and standards deviation pair samples test difference between score total and score total verified, The mean score for pair sample shown that the score total from the organization's self assessment were higher than the score total verified by the external assessor. From the graph of percentage of mean results pair samples statistics, it was implying the Higg Index FEM Module assessment conducted by the organization generally evaluated higher value score than the external assessor 's result with 33% higher where self-assessment mean score 57.317 and external assessor mean score 38.252 as shown in table 5.4.1. It is concluded that results from the external assessor were higher significant impact than the results from the organization.

From the table 5.5, pair different mean of pair sample for score total & score total verified were 19.0649, and standard deviation is 10.0948, in the meanwhile the e pair test samples correlation were 0.651 were significant strong positive correlation between score total & score total verified. (r=0.651) shown in table 5.4.2.

The Wilcoxon Signed statistics results for the non parametric where the 7 parameters consist of normal and non-normality value for p-value are shown in tables 5.5.1 to 5.5.7. Among the 7 parameters from the module assessment criteria, table 5.5.1 water score verified & water score,(mean rank-9.0, p=0.000 z=-3.66) ; table 5.5.2 air scored & air score verified, (mean rank 6.68, p=0.007, z=-2,712); chemical score verified & chemical score verified (mean rank 11.50, p =0.00 and z=-4.108); EMS & EMS score verified (mean rank 10.47, p=0.00 z=-3.777); Energy scoer & Energy Score verified

(Mean rank=5.00, $p=0.007$, z –2.68); Waste Score & Waste Score Verified (Mean Rank=10, p=0., z=-4.108) was rated more favorably to the external assessor score.

Furthermore, the relationship between the dependent variable results were shown in table 5.6.1, where the p value was 0.015 ($p<0.05$), indicating that the correlation matrix is significantly between the variables. Table 5.6.2 results show that the KMO value (> 0.6) and the waste score with value 0.650 were the most significant factors in the assessment results. The table 5.6.3 is retested to confirm the KMO value, and it is revealed that the waste score with the highest value, 0.807, is shown.

Meanwhile, table 5.6.4 external assessor results indicate that the p value with the 0.00 (0.05) variable was significantly correlated, and table 5.6.5 results show that the KMO value (> 0.6), the water score 0.68, and the wastewater score 0.607 were the highest among parameters. The table 5.6.6 SPSS Output 6 was retested to confirm the KMO value, and it shows that water has a score of 0.825 and wastewater has a score of 0.779.

The results of the KMO factorial analysis were shown in table 5.6.2 SPSS Output 1 and table 5.6.4 & table 4.6.5 SPSS Output that the parameter, waste, contributed the highest significance that impact the sustainability score of Higg Index Module from the perspective view of the organisation itself, while the water score with value 0.680 and wastewater with value 0.607 both factors contribute to the significant impact to Higg Index FEM Module assessments.

CHAPTER 6: CONCLUSION

In conclusion, the SPSS data indicated that the external assessor is critical in evaluating the significance of the sustainability index score on the assessment findings, and that external assessors can serve as standard benchmarks for the organization to be follow.

It is to conclude that the following o the research project's objectives is to evaluate the significance of impact of Higg Index module FEM 3.0 scoring towards the apparel manufacturing in Bangladesh.

- To investigate the environment impact level of Higg Index FEM scoring among applicability question

  Results: Table 4.2 results were shows that score total & score total verified of the Higg Index FEM Module , both results were normally distributed , where the test normality p value significance more than 0.05 and it significantly impact on the scoring of the Higg Index FEM scoring assessment.

- To identify the main applicability in the Higg Index module FEM 3.0

  Results: In comparison of the table result 5.6.2 & 5.6.5 SPSS Output, the main applicability that contribute the Higg Index FEM Scoring were mainly contributed by the water score 0.68 and wastewater score 0.607 with analyzed with factorial analysis from the perspective view of external assessor.

- To associated the significant impact of scoring between self assessment and external assessment.

  Results: From the table 5.4.1 Results of Mean between pair samples statistics of score total, 57.317 done by the organization facility and score total verified, 38.252

by the external assessor , differences total were shown in table 5.5 with 19.06499 and the results were compared in the Graph 1 percentage differences between self-assessment and external shown that self assessment results with 33% higher than the external assessor results. It is implied that organization were evaluated the scoring much more higher than the external assessor and the results of external assessor can be a reference standards or guidelines.

Future Work Recommendations

The research can be further included in other tools offered by the SAC, such as the Higg Product Module (Higg MSI) and the Higg Brand Tool (Higg BRM), that have not yet been done and investigated, based on the outcomes that were reached in the thesis. In addition, social impact factors such as the (Higg FSLM) that effect textile sector sustainability can be investigated further in future research. Furthermore, Higg Index FEM study can be further used to tier 2 and tier 3 supply chain sectors.

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