Prioritization of Sustainable Strategies for an Apparel Industry Using QFD

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In order to turn from traditional manufacturing into a sustainable manufacturing it is essential to put efforts on assimilating three different aspects such as economic, social, and environmental. Usually, stakeholders of a company expect that their company should focus on consideration of all these aspects in their strategic decisions towards sustainability. Therefore, the voice of stakeholders is a core element in establishing sustainable initiatives. In this work, an attempt has been made to develop a methodology using the Quality Function Deployment (QFD) technique for establishing and prioritization of sustainable strategies for apparel manufacturing companies through considering the perception of stakeholders.
Keywords: Sustainability, Voice of stakeholders, QFD, Factor Analysis, Analytic Hierarchy Process

1. Introduction

A sustainable manufacturing company operates with a clear focus on the environmental and social circumstances to manufacture its products and deliver its services. It produces items with minimal or negligible environmental emissions, proper utilization of raw materials, and adopting sound practices of reducing energy consumption. To turn from traditional manufacturing into sustainable manufacturing it is essential to put efforts into assimilating three different aspects such as economic, social, and environmental (Malek and Desai, 2019). The apparel industry sector in India needs to implement appropriate strategies for ecological, social, and economic sustainability. Of course, the apparel industry holds a key position in the economic landscape of India. It provides around 2.3% of India's GDP and textile exports represent 12% of its foreign exchange profits (Vishwakarma et al., 2022). This sector provides inclusive growth in employment as it is suitable both for qualified and unqualified employees. The textiles and apparel industry in India is the second-largest employer in the country providing employment to about 45 million people (Berwal, 2020). Though the role of this sector is significant for economic growth and provides employment to a certain extent it pollutes the environment more. In fact, the apparel industry contributes to the pollution of the environment at every stage of its supply chain. As it pollutes the air, water, and soil, it has been recognized as the second most polluting industry after the oil industry. The emission of greenhouse gases pollutes the air which badly affects high on human life. Garment dyeing operation pollutes water, and it makes water highly toxic as it contains various chemicals. If such water is allowed to any nearby water resources leads to the destruction of flora and fauna as well as aquatic life. The toxic water effluents usually contain heavy metals that are responsible for soil pollution. The natural ecosystem suffers greatly from clothing production to disposal stages (Vishwakarma et al., 2022; Abbate et al., 2024). Often, apparel manufacturing companies in some of the developing countries are taking advantage of engaging cheap labor. At the same time, it is highly required to implement fair wages for employees, provide suitable working conditions, and focus on well-being of the workforce. In order to promote the economic direction of sustainability it is necessary to focus on minimization of wastage through implementing new technologies.

Amid all the economic, ecological, and social perspectives, the apparel industry has to establish sustainable strategies to produce high-quality products and services being safer for society and all its stakeholders and being able to mitigate social and environmental impacts throughout its life cycle. Usually, stakeholders of a company expect that the company should focus on consideration of both the environmental and social issues in all its decisions. Stakeholders are not merely passive observers but should be active participants in a company's sustainability strategy, offering unique contributions at various levels of the process. Therefore, stakeholder engagement is a core element in establishing sustainable initiatives (Bal et al., 2013). In this point of view, a methodology has been developed in this paper with the help of Quality Function Deployment (QFD) for extending stakeholders' perception in establishing and prioritizing sustainable strategies for the apparel industry. Other techniques such as Factor Analysis (FA) and Analytic Hierarchy Process (AHP) are used in developing the methodology. The FA was employed to reduce the list of stakeholders' requirements and AHP has been used to prioritize the stakeholders' requirements. The outcome of QFD provides the priority ranking of the strategies that direct the apparel industry towards sustainability. The rest of the paper is organized as follows. The review of literature on QFD, FA, and AHP techniques is presented in Section 2. Section 3 is devoted to the methodology for the establishment and prioritization of sustainable strategies in the apparel industry using the proposed QFD approach. Following that the Results and discussions are presented in Section 4. Finally, the Conclusions and future scope are presented in Section 5.

2. Review of Literature

The overview of the techniques used in the methodology is discussed briefly in the following paragraphs.

2.1 Quality Function Deployment

Quality function deployment (QFD) is a customer-driven product planning technique that was originally developed in the late 1960s. It helps to translate the customer needs into appropriate product design requirements for developing products to meet the satisfaction of customers. Numerous attempts made to use the QFD technique for customer-focused product development in various fields have been reported in literature. Though QFD technique was introduced to address quality issues at various stages of the product development process, later on, it was adopted for decision-making in different fields such as health care, education, marketing planning, supply chain management, etc. (Prasad et al., 2021). The application of QFD also has been extended to support strategic planning of various activities (Jia and Bai, 2011; Chowdhury and Quaddus, 2016; Sousa-Zomer and Miguel, 2017) as its philosophy provides a scope to involve stakeholders and consider stakeholders' voice in decision making. Originally QFD methodology possessed four sequentially linked matrices, most of the studies used the first matrix of QFD which deals with product planning. This matrix is called House of Quality (HoQ) which consists of horizontal and vertical portions. The horizontal portion is the 'customer portion' which contains customers' requirements and their priority ratings. The vertical portion is the 'technical portion' in which technical requirements are to meet the customer's needs. The intersection of these two portions forms an inter-relationship matrix in which the exact translation of customer requirements into technical requirements. The strength of the relationships is presented in the cells of the matrix usually with the help of a rating scale of 0 - 1 - 3 - 9 to represent no, weak, medium, and strong relationships respectively. values of the inter-relationship matrix indicate the strength of the relationship respectively (Prasad et al., 2022). The absolute importance of each technical requirement is calculated by summing the products of the weightages of the customer needs and the corresponding inter-relationship values in the respective technical requirements column. The normalization of the absolute importance scores of the technical requirements gives the relative importance values of the technical requirements. These relative importance values indicate the priority order of technical requirements. This outcome of HOQ guides the design team to focus on technical requirements in priority order to meet the customer requirements. In this work, the first matrix of QFD has been used in developing the methodology for capturing the voice of stakeholders and extending into the establishment of sustainable strategies.

2.2 Factor analysis (FA)

Factor analysis (FA) is a multivariate statistical technique that can be used as a tool for questionnaire survey analysis. It is specifically suitable when it is required to extract a few factors from a large number of related variables in a reasonable and manageable manner. It helps when the investigator is required to know the variables in a single set form logical subsets that are relatively independent of one another. Sometimes it may happen that the questionnaire contains irrelevant statements that can be removed from the final questionnaire using FA (Noora,2021). The FA clusters similar variables into the same factor to identify underlying variables using a data correlation matrix. To conduct factor analysis all the variables have to correlate to some extent and the variables should be measured at the ordinal level. There are two approaches for FA namely confirmatory factor analysis and exploratory factor analysis. At the early stages of research, it is advisable to use exploratory factor analysis as it helps to gather data about the interrelationships among a set of variables. In the present work exploratory factor analysis is employed to extract factors to be considered for establishing sustainable strategies of the apparel industry. The EFA procedure consists of three major steps: identifying the method of extracting the components, factor extraction, and factor rotation. The principal component analysis is the widely used method for extracting factors. The scree plot indicates the eigenvalues against the number of factors in order of extraction. It helps to determine the number of factors. The number of factors to be determined depends on different approaches based on eigenvalues, scree plot, percentage of variance accounted, etc. The purpose of rotation is to simplify and clarify the data structure and it helps to determine the least number of factors. There are two types of rotations namely orthogonal rotation and oblique rotation. Orthogonal rotation produces uncorrelated factors, whereas oblique rotation produces correlated factors. In this work, orthogonal rotation is used as it produces more easily interpretable results. There are different methods of orthogonal rotation such as varimax, quartimax, and equamax. In this work the principal component method followed by the varimax rotation is adopted by using SPSS20.0 package. Formal statistics such as Kaiser Meyer-Olkin's (KMO) measure of sampling adequacy and Bartlett's test of sphericity are used for testing the appropriateness of the data to proceed with factor analysis. KMO measure is an index that compares the size of the observed correlation coefficients to the sizes of the partial correlation coefficients. The value of KMO between 0.5 and 1.0 indicates the factor analysis is appropriate (Shrestha, 2021). Bartlett's Test of Sphericity is used to test the null hypothesis that variables are uncorrelated to each other. A higher value of chi-square indicates the rejection of the null hypothesis. If this hypothesis cannot be rejected, then the appropriateness of factor analysis should be questioned. The significance level gives the result of the test. Very small values of significance (below 0.05) indicate that the use of factor analysis is appropriate for the data set. During the interaction with the stakeholders of the apparel industry, it is observed that they have more expectations in view of attaining sustainability. If the stakeholders' requirements list is high that leads to complexity in the construction of HOQ, which is one of the limitations of QFD. Therefore, the list of stakeholders' requirements should be minimal to a possible extent without sacrificing their perception. In order to reduce the size of the list of requirements, FA has been employed in the proposed methodology and consequently, the complexity in establishing HOQ matrix is being reduced.

2.3 Analytic Hierarchy Process (AHP)

Analytic hierarchy process (AHP) is one of the most widely used multi-criteria decision-making (MCDM) techniques in various studies in different fields. This method uses pair-wise comparison between criteria on the basis of scale of importance called Saaty scale which guides the decision-makers to assign the importance of one criterion over the other. The prioritization of criteria using AHP involves four major steps such as hierarchy construction, establishment of pair-wise comparison matrix (PCM) through performing pair-wise comparisons of all the elements with the help of Saaty scale, calculation of eigenvalues of the PCM and checking the consistency of pair-wise judgments (Prasad et al., 2021). Several studies have been carried out extensively on AHP in several applications related to MCDM situations for the past three decades. In most recent times AHP is integrated with other techniques for solving complex MCDM problems. Numerous attempts have been made to use AHP in QFD methodology and has proved that AHP provides the best solution to determine the priorities of customer needs in the HOQ matrix (Mastura et al.,2018). To address various decision-making situations a large number of QFD-AHP integrated approaches have been reported in the literature. Ginting and Ishak (2020) have reviewed various research articles about AHP-QFD and concluded that the integration of AHP into the QFD process can implement QFD effectively in the process of the development of a new product. Kürüm Varolgüneş et al., (2021) designed a thermal hotel based on AHP-QFD Methodology. El Badaoui and Touzani (2022) proposed AHP QFD methodology for a recycled solar collector. The AHP serves as a tool to prioritize the evaluating criteria derived from the requirements of company stakeholders. Abdel Basset et al. (2018) proposed an integrated neutrosophic AHP-QFD approach for identifying the best supplier from different alternatives. Prasad et al., (2024) employed AHP to prioritize the ergonomic needs of users in HOQ matrix.

3. Research Methodology

In this work, a methodology has been developed by using QFD with the support of FA and AHP to establish sustainable strategies for the apparel industry. Figure 1 shows the flow diagram for implementing the proposed methodology for establishing and prioritizing sustainable strategies.

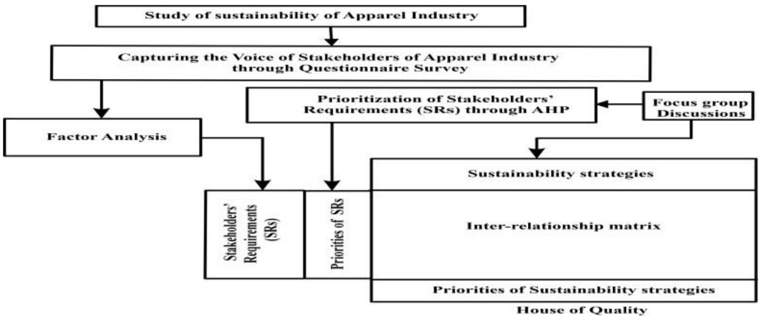

Figure 1 *Flow Diagram of the Proposed Methodology for Prioritizing Sustainability Strategies*

3.1 Prioritization of Sustainable strategies of the Apparel industry Using QFD Approach

The stakeholders are typically related to the inter-relationship between the apparel industry and different groups of individuals, i.e., shareholders, employees, suppliers, customers, environment, community, government, etc. The requirements of the stakeholders are usually identified by interacting directly with them by asking what are their expectations in strategic decisions of the apparel industry towards achieving sustainability. A questionnaire survey helps more for a thorough understanding of the perception of stakeholders. After frequent personal interactions with various stakeholders, a questionnaire was prepared, and it was finalized after thorough revision. The questionnaire is shown in Annexure 1 and it was administered to 135 respondents of various categories of stakeholders under different demographics such as different age groups, gender, education level, and occupation. The respondents were asked to indicate the degree of importance of their requirements in terms of a five-point Likert scale (1 = not important, 2 = slightly important, 3 = somewhat important, 4 = important, 5 = very important). To obviate the difficulty of including all the needs in the stakeholders' portion of HOQ, and to reduce the complexity in constructing HOQ, exploratory factor analysis is performed for the data obtained through questionnaire survey. The exploratory factor analysis is performed with the help of SPSS 20.0 package. Kaiser-Meyer-Olkin (KMO) measure of the sample adequacy was used to validate the use of factor analysis. It is an index used to examine the appropriateness of factor analysis. The results of KMO and Bartlett's test are summarized in Table 1.

Table 1 *KMO and Bartlett's Test*

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		**0.835**
Bartlett's test of sphericity	Approx. Chi-Square	1527.987
	df	210
	Sig.	0.000

From Table 1, it is observed that the KMO value is 0.835 and the significance value is 0.000. Therefore, the data is appropriate to proceed with factor analysis. The FA starts with selecting the method of extracting the components and then decides the number of components to be extracted. In this work Principal component method of extraction and the varimax method of rotation are employed. Communality is the amount of variance a variable shares with all the other being considered. Communalities indicate the amount of variance in each variable that is accounted for. Initial communalities are estimates of the variance in each variable accounted for by all components or factors. Extraction communalities are estimates of the variance in each variable accounted for by the factors (or components) in the factor solution. Small values indicate variables that do not fit well with the factor solution and should possibly be dropped from the analysis. Table 2 shows the communalities.

Table 2 *Communalites*

Q	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11
Initial	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Extraction	0.800	0.619	0.588	0.603	0.505	0.670	0.752	0.690	0.764	0.487	0.521
Q	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	
Initial	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
Extraction	0.555	0.774	0.724	0.738	0.687	0.612	0.591	0.793	0.760	0.701	

From Table 2, it is to be noted that all the variables have their communalities above 0.4 which is desirable. The eigenvalue represents the total variance explained by each factor. The eigenvalues associated with each linear component before extraction, after extraction, and after rotation are listed in Table 3.

Table 3 *Total Variance Explained*

Component	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	Percentage of variance	Cumulative Percentage	Total	Percentage of variance	Cumulative Percentage	Total	Percentage of variance	Cumulative Percentage
Q1	7.513	35.774	35.774	7.513	35.774	35.774	3.653	17.395	17.395
Q2	2.731	13.007	48.781	2.731	13.007	48.781	3.419	16.280	33.675
Q3	1.373	6.536	55.317	1.373	6.536	55.317	2.931	13.955	47.630
Q4	1.281	6.101	61.418	1.281	6.101	61.418	2.740	13.049	60.679
Q5	1.038	4.943	66.362	1.038	4.943	66.362	1.193	5.683	66.362
Q6	0.857	4.079	70.441						
Q7	0.826	3.932	74.373						
Q8	0.719	3.425	77.798						
Q9	0.657	3.128	80.926						
Q10	0.622	2.960	83.886						
Q11	0.533	2.537	86.422						
Q12	0.510	2.427	88.849						
Q13	0.430	2.045	90.894						
Q14	0.367	1.746	92.641						
Q15	0.323	1.538	94.179						
Q16	0.300	1.431	95.609						
Q17	0.251	1.197	96.806						
Q18	0.202	0.960	97.766						
Q19	0.198	0.942	98.708						
Q20	0.173	0.825	99.533						
Q21	0.098	0.467	100.00						

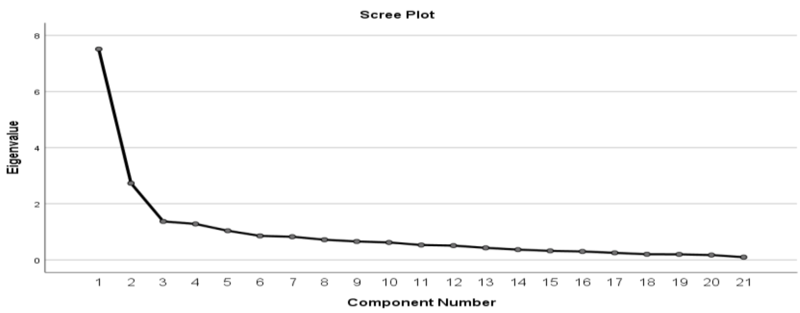

Figure 2. *Scree Plot*

From Table 3, it should be clear that the first five factors explain relatively large amounts of variance whereas the subsequent factors explain only small amounts of variance. The extraction sums of the squared loadings group give information regarding the extracted factors or components. For principal components extraction, these values will be the same as those reported under Initial eigenvalues. The variance accounted for by rotated factors or components may be different from those reported for the extraction but the cumulative percentage for the set of factors or components will always be the same. A Scree plot is shown in Figure 2 which indicates the eigenvalues against the number of factors in order of extraction (Dixit and Singh, 2020). From the Scree plot, a distinct break occurs at five factors. The plot suggests that the five factors appear to be reasonable. In order to easily interpret the factors, the rotated component matrix is obtained by using varimax rotation. The partitions of five mutually exclusive groups are formed, which are shown in Table 4.

Table 4 *Rotated Component Matrix*

	Component				
	1	2	3	4	5
Q13	0.812				
Q14	0.785				
Q15	0.785				
Q12	0.674				
Q16	0.670				
Q20		0.824			
Q19		0.815			
Q21		0.755			
Q18		0.598			
Q17		0.537			
Q2			0.767		
Q4			0.733		
Q3			0.726		
Q5			0.637		
Q10			0.570		
Q9				0.812	
Q7				0.806	
Q8				0.717	
Q11				0.544	
Q6					0.551
Q1					0.883

The first group of variables signifies the reduction of wastage and disposal of chemicals. The variables in the second and third groups are employee skills and customer satisfaction respectively. The aspects related to the welfare of employees in the working area and loyalty to customers come under the fourth and fifth groups respectively. The factors obtained from 1 to 5 are labeled as Waste reduction and disposal of hazardous chemicals (WRDHC), Enhancement of employee skills (EES), Customer satisfaction (CS), Welfare of employees in the working environment (WEWE), Loyalty to customers (LC) respectively. These are the stakeholders' requirements (SRs) in view of achieving sustainability for the apparel industry, which are shown in Table 5.

Table 5 *Survey Questions and Stakeholders' Requirements (SRs)*

Sl. No	**Variable in the questionnaire**	**Stakeholders' requirements (Factors)**
1	Q12, Q13, Q14, Q15, Q16 (Factor 1)	Waste reduction and disposal of hazardous chemicals (WRDHC)
2	Q20, Q19, Q21, Q18, Q17 (Factor 2)	Enhancement of Employee skills (EES)
3	Q2, Q3, Q4, Q5, Q10 (Factor 3)	Customer satisfaction (CS)
4	Q7, Q8, Q9, Q11 (Factor 4)	Welfare of employees in working environment (WEWE)
5	Q1, Q6	Loyalty to customers (LC)

With the help of AHP technique the stakeholder's requirements have to be prioritized. A focus group has been constituted with the decision makers in various departments of the apparel industry, experts in the field of strategic thinking, and researchers in the field of sustainability. The brainstorming sessions were conducted with the experts of the group to prepare the pair-wise comparison matrix of stakeholders' requirements. The pair-wise comparison matrix shown in Table 6 is established with the help of Saaty scale.

Table 6 *Pair-Wise Comparison Matrix of SRs*

	WRDHC	**EES**	**CS**	**WEWE**	**LC**
WRDHC	1	4	5	2	5
EES	1/4	1	5	1/2	3
CS	1/5	1/5	1	1/3	2
WEWE	1/2	2	3	1	3
LC	1/5	1/3	1/2	1/3	1

The normalized pair-wise comparison matrix shown in Table 7 is prepared by calculating the sum of the elements in each column of the comparison matrix and then dividing each element in a column by the sum of the elements in the respective column. Next, calculate the sum of the elements in each row and divide the sum by the total number of requirements. The resulting computation is referred to as the criteria comparison normalized vector which is the priority structure (weightages) of the requirements. The weightages for all the SRs are computed and are shown in the last column of Table 7.

Table 7 *Normalized Pair-Wise Comparison Matrix of SRs*

	WRDHC	**EES**	**CS**	**WEWE**	**LC**	**Row sum**	**Priority ratings (weightages)**
WRDHC	0.465	0.531	0.345	0.480	0.357	2.178	0.436
EES	0.116	0.133	0.345	0.120	0.214	0.928	0.186
CS	0.093	0.027	0.069	0.080	0.143	0.411	0.082
WEWE	0.233	0.265	0.207	0.240	0.214	1.159	0.232
LC	0.093	0.044	0.034	0.080	0.071	0.323	0.065

In order to verify the consistency of the pairwise comparison matrix, Saaty proposed consistency index (CI) and Consistency ratio (CR). The CI and CR are defined as follows.

$$CI = \frac{\lambda_{\max} - n}{n-1} \quad (1)$$

$$CR = \frac{CI}{RI} \quad (2)$$

Where λ_{max} = Maximum principal eigenvalue of the comparison matrix
n = Number of elements
RI = Random index

The value of λ_{max} is obtained by first multiplying the pair-wise comparison matrix with the priority matrix. Then divide the first element of the resulting matrix by the first element of the priority matrix, the second element of the resulting matrix by the second element in the priority matrix, and so on. A single-column matrix is obtained and the average of the elements of the matrix gives the value of λ_{max}.
The computations are given below.

$$\begin{bmatrix} 1 & 4 & 5 & 2 & 5 \\ \frac{1}{4} & 1 & 5 & \frac{1}{2} & 3 \\ \frac{1}{5} & \frac{1}{5} & 1 & \frac{1}{3} & 2 \\ \frac{1}{2} & 2 & 3 & 1 & 3 \\ \frac{1}{5} & \frac{1}{3} & \frac{1}{2} & \frac{1}{3} & 1 \end{bmatrix} \times \begin{bmatrix} 0.436 \\ 0.186 \\ 0.082 \\ 0.232 \\ 0.065 \end{bmatrix} = \begin{bmatrix} 2.376 \\ 1.016 \\ 0.413 \\ 1.262 \\ 0.332 \end{bmatrix}$$

$$\begin{bmatrix} \frac{2.376}{0.436} \\ \frac{1.016}{0186} \\ \frac{0.413}{0.082} \\ \frac{1.262}{0.232} \\ \frac{0.332}{0.065} \end{bmatrix} = \begin{bmatrix} 5.455 \\ 5.472 \\ 5.021 \\ 5.442 \\ 5.137 \end{bmatrix}$$

$$\lambda_{\max} = \frac{5.455 + 5.472 + 5.021 + 5.442 + 5.137}{5} = 5.305$$

The random index (RI) represents the average consistency index for numerous random entries of same-order reciprocal matrices. The value of RI corresponds to the number of criteria (elements) n involved in decision-making. The value of RI corresponding to n = 5, is 1.12.

$$CI = \frac{5.305 - 5}{5 - 1} = 0.07634$$

$$CR = \frac{0.07634}{1.12} = 0.06816$$

The value of CR obtained is 0.06816, which is less than 0.10, and hence the AHP results were consistent.
Once the weightages of the SRs are determined, the next step is to establish sustainability strategies to fulfill the stakeholders' requirements through conducting brainstorming sessions among the focus group members. The outcome of the discussions explored seven strategies for the sustainability of the apparel industry which are shown in Table 8.

Table 8 *List of Sustainability Strategies for the Apparel Industry*

Sl. No	Sustainability strategies
1	SS1: Empowering of workforce
2	SS2: Employee health and well-being
3	SS3: Maintaining eco-friendly and respectful workplace
4	SS4: Corporate social responsibility
5	SS5: Adopt renewable energy technologies to mitigate emissions
6	SS6: Zero discharge of hazardous chemicals
7	SS7: Managing waste through RRR (Reduce, Reuse, Recycle) policy

In order to deploy the stakeholders' perception into the prioritization of sustainability strategies, the HOQ matrix has to be developed. The HOQ is developed by establishing an inter-relationship matrix and then determining the absolute importance values of the revised DRs. On the basis of the strength of the relationships among stakeholders' requirements and sustainability strategies, the inter-relationship matrix will be developed. Once the strength of the relationships is assessed, a three-point ordinal scale of 1- 3- 9 may be used to denote weak, medium, and strong relationships between them. Through focus group discussions the cell values of the inter-relationship matrix are filled, and the resulting HOQ is shown in Table 9.

Table 9 *HOQ Matrix*

Stakeholders' Requirements (SRs)	Weightages of SRs	Sustainability strategies for the apparel industry						
		SS1	SS2	SS3	SS4	SS5	SS6	SS7
WRDHC	0.436	3	9	9	9	3	9	9
EES	0.186	9	3	3	3	1	3	3
CS	0.082	3	3	9	9	3	9	3
WEWE	0.232	9	9	3	9	3	9	3
LC	0.065	1	3	3	9	3	3	3
Absolute scores		5.376	7.005	6.107	7.886	2.629	7.498	5.614
Relative importance values		0.128	0.166	0.145	0.187	0.062	0.178	0.133
Rank order		6	3	4	1	7	2	5

The absolute importance score of each strategy is determined by summing the products of the priority ratings of stakeholders' requirements and the corresponding inter-relationship values in the respective sustainability strategy column. The normalization of the absolute importance scores gives the relative priority ratings of the sustainability strategies. For instance, the computation of absolute score and relative importance value for the strategy SS1 are given below.
Absolute score for SS1 = (0.436×3) +(0.186×9) +(0.082×3) +(0.232×9) + (0.065×1) = 5.376

Relative importance value of SS1 = $\frac{5.376}{42.11} = 0.128$

In the same way, the absolute values and relative importance values for all the remaining sustainability strategies were computed and are shown in Table 9. The relative importance values provide the rank order for the implementation of the strategies for attaining sustainability in the apparel industry.

4. Results and Discussion

The outcome of the research explores the ranking of the sustainability strategies of the apparel industry based on the relative importance values of the sustainability strategies. From Table 9 it has been observed that SS4 has the highest rank. Therefore, the apparel industry needs immediate attention on corporate social responsibility (CSR) for its sustainability. In fact, CSR is the process by which a firm maintains a balance of economic, environmental, and social obligations in accordance with the aspirations of shareholders and stakeholders. Most small-size manufacturing companies are not implementing CSR often because of lack of awareness of CSR. Instead of looking CSR as an additional expense and added burden, manufacturing firms need to understand the benefits that could be gained through implementing CSR such as employee retention, more employee commitment, and improving the image of the firm. If the working conditions provided are good and treat the employees well, employees are willing to continue to stay with the company with good commitment. The result of the study discloses that SS6 i.e., Zero discharge of hazardous chemicals (ZDHC) has second rank and hence after the CSR the immediate focus on ZDHC is essential for achieving sustainability. There are a number of processes involved in the production of one piece of clothing that consumes chemicals, energy, and water which affects the environment more. Advanced digital solutions like data analytics, Internet of Things, and Artificial Intelligence can optimize the production processes to minimize the loss of energy and saving of resources. These technologies will be the game-changer in the quest to conserve water and energy. Therefore, manufacturing firms need to prepare a constructive roadmap immediately for adopting new technologies to ensure zero discharge of hazardous chemicals. In this study, the SS2 (Employee health and well-being) has third rank and hence after CSR and ZDHC, the apparel industry is required to concentrate on employee health and well-being as it directly impacts productivity, growth, and sustainability. The priority order obtained through the methodology will guide the apparel industry to make wise decisions in all aspects to make it sustainable in the near future.

5. Conclusions and Future Scope

In this paper, an attempt has been made to develop a structured methodology for deploying the stakeholders' perceptions and expectations into the sustainability strategies of the apparel industry. The role of QFD in the proposed methodology makes the decision-making on sustainability strategies stakeholder centric. The involvement of stakeholders leads to give a scope to know the ground reality of various aspects that seriously affect sustainability. The rank order obtained with the implementation of the proposed methodology provides a path for orderly focusing on strategies towards reaching the goal of sustainability of apparel industry. Though the proposed methodology is simple and structured, there may be scope for involving some uncertainties and ambiguines due to subjective perceptions and experiences that have been taken into consideration in various stages of the methodology. The work may further be extended to adopt fuzzy technique in the methodology for resolving the issues of vagueness and imprecision in an effective manner.

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Annexure 1: Questionnaire

Kindly indicate the degree of importance of requirements of stakeholders in view of establishing sustainable strategies of apparel industry. Mention your response with a tick mark in the appropriate box on the basis of the following scale.
Note: 1 – Not important; 2 – Slightly important; 3 - Somewhat important; 4 – Important; 5 – Very important

Q.No	Question	1	2	3	4	5
Q1	How important is it for you to frequently purchase new clothing items?					
Q2	What role does price play when considering clothing purchases?					
Q3	How does quality influence your decision when purchasing clothing?					
Q4	To what extent does aesthetics affect your choice in buying clothing?					
Q5	How important is durability in your clothing purchase decisions?					
Q6	What is your view on the significance of delivery time in clothing purchases?					
Q7	How impactful do you find awareness of eco-friendly materials on a company's sustainability practices when making purchasing decisions?					
Q8	How does knowledge of ethical practices influence your buying choices regarding sustainability?					
Q9	How significant is a company's involvement in CSR activities in your purchasing decisions?					
Q10	To what degree does a company's brand reputation affect your view on its sustainability practices?					
Q11	How important is the adoption of technology to enhance workplace safety in a company's sustainability efforts?					
Q12	How crucial are environmental policies like avoiding harmful and hazardous chemicals for achieving sustainability?					
Q13	What importance do you place on recycling as a component of environmental management for sustainability?					
Q14	How does reuse feature in your view of effective environmental management policies?					
Q15	How important is waste reduction in your perception of a company's sustainability practices?					
Q16	How significant is waste disposal in evaluating a company's environmental management efforts?					
Q17	How essential is accountability among company executives in adhering to sustainable practices?					
Q18	To what extent do you value sustainable innovation in leadership roles when it comes to sustainable practices?					
Q19	How important is inventory management in company executives' adherence to sustainability?					
Q20	How valuable is maintaining stakeholder relationships in promoting sustainable practices by company leaders?					
Q21	How critical is technology upgrading in ensuring company executives follow sustainable practices?					