# Supply chain sustainability through complying buyers' requirements in apparel industry: A fuzzy QFD approach

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**ABSTRACT**

*Sustainability in supply chain has become a unanimously important research agenda in business, as stakeholders are demanding sustainability in the whole chain rather than individual organization. A number of research works have been conducted on sustainability but research on sustainability in supply chain is not substantial in number. Even, research on identifying sustainability requirements of supply chain partners and finding corresponding mitigation approach is very scarce. Therefore, this study aims at identifying sustainability requirements of buyers in apparel industry and corresponding design requirements by applying fuzzy-QFD approach. Study finds that usually, buyers demand for seven social and environmental compliance issues. It is also appeared that as many as nine sustainability design requirements are important for mitigating the buyers' compliance requirements. The relationship among the sustainability design requirements has also been enumerated in the paper. Finally, all these findings have been coalesced and depicted by a House of sustainability (HOS) model.*

*Keywords: Sustainability, supply chain, buyers' requirements, Fuzzy-QFD, HOS.*

## 1. INTRODUCTION

Sustainability in supply chain is now an issue of renewed focus in the business world as the stakeholders requirements are converging towards sustainability (Wheeler et al., 2003)(Seuring and Muller, 2008). ()()()With the passage of time Stakeholders are demanding for social and environmental sustainability along with economic sustainability in the supply chain (Carter and Rogers, 2008). Supply chain is often jeopardised by myriads of economic, social and environmental incidents. As a result supply chain sustainability is inevitable. A sustainable supply chain can manage material, information and capital flow and cooperate among all entities in the chain with a view to achieve the economic, environmental and social goals by integrating customer and stakeholder requirements (Seuring and Muller, 2008). Sustainability has gained even more focus to stakeholders because of the high profile corporate failures in an attempt to promote good governance (Aaronson, 2002). Moreover, non-compliance and violation of social and environmental issues is not unlikely in the corporations of many countries such as Bangladesh, Pakistan and others (Naeem and Welford, 2009) and more specifically in human intensive organizations such as apparel industry (Islam and Deegan, 2008; Ahmed and Peerlings, 2009). These sorts of non-compliance often create pressure in the chain from customers and stakeholders to ensure social and environmental sustainability (Hossan et al., 2012; Islam and Deegan, 2008).

A number of researchers (Carter and Rogers, 2008); (Carter and Easton, 2011); (Pagell and WU, 2009), (Seuring and Muller, 2008) conducted research on sustainable supply chain but there are still fundamental issues that need to be addressed to assist business managers and supply chain professionals to achieve supply chain sustainability (Pagell and WU, 2009). Moreover, empirical research focusing on social and environmental sustainability to integrate stakeholders' requirements is still lacking. In this theoretical lacuna the research endeavour is to develop a house of sustainability (HOS) model which will address the social and environmental sustainability requirement of stakeholders in the supply chain. A QFD approach which can address customers' requirements and integrate those requirements in design functions (Delice and Güngör, 2010)is appropriate in this situation to integrate and meet the sustainability requirements of buyers and stakeholders.

## 2. RELATED WORKS

### 2.1 Supply chain sustainability and stakeholders requirement:

**S**ustainability in supply chain is introduced by most researchers as sustainable supply chain management. Sustainable supply chain management has got substantial interests to academic and corporate world just over a decade(Carter and Rogers, 2008). Sustainability has been realized to be a strategic weapon in businesses and their supply chain as it has a pulling effect in the market deriving from customers demand (Liedtke and Schaller, 2006). For achieving sustainability in supply chain a balance needs to be maintained among social, environmental and economic goals and corresponding stakeholders' requirements (Carter and Rogers, 2008), (Carter and Easton, 2011). In line with this stakeholder theory advocates that the task of management is to maintain a balance among the conflicting interests and claims of stakeholders. If a balance cannot be ensured, organizational sustainability will be questioned (Freeman, 1984). So, supply chain managers need to address the requirements of key stakeholders to achieve sustainability in the chain. A sustainable organization tries to maximize social and environmental performance along with economic performance for a sustainable and value based stakeholder relation (Perrini and Tencati, 2006). The focal point is that Sustainable supply chain has now become customer, government and stakeholders requirement (Seuring and Muller, 2008) and that's why organizations and their supply chains try to integrate sustainability in the strategy to meet stakeholders' expectations and to gain satisfaction (Aragón-Correa and Sharma, 2003).

**2.2 Quality function deployment (QFD):**

QFD is a systematic process used by cross-functional teams to identify and resolve the issues involved in providing products, processes, services, and strategies that enhance customer satisfaction (González et al., 2004). QFD model supports the product design and development process, which was laid out in the late 1960s to early 1970s in Japan by Akao(1990). QFD is based on collecting and analysing the voice of the customer that help to develop products with higher quality and meeting customer needs (Delice and Güngör, 2010). The benefits of this model have been emphasized by various researchers, such as, Sullivan (2006), Hauser and Clausing (1988), Zairi and Youssef (1965), Chan and Wu (2002), and Terninko (2000). Although the popular application fields of QFD are product development, quality management and customer needs analysis, but the utilisation of QFD method has spread out to other manufacturing fields in time (Chan and Wu, 2002). Recently, companies are successfully using QFD as a powerful tool that addresses strategic and operational decisions in businesses (Mehrjerdi, 2010). In using QFD, organisation will be able to achieve reduction in the number of design changes, lower start-up costs, shorter design cycles, fewer warranty claims, improved internal communications, and increased sales (Griffin and Hauser, 1993). In addition, QFD is also used in various fields for determining customer needs (Stratton, 1989), developing priorities (Han et al., 1998), formulating annual policies (Philips et al., 1994), manufacturing strategies (Crowe and Cheng, 1996; Jugulum and Sefik, 1998), benchmarking (Pfohl and Ester, 1999), and environmental decision making (Berglund, 1993). Chan and Wu (2002) and Mehrjerdi (2010) provide a long list of areas where QFD has been applied successfully. The benefits that are pointed by researchers in the literature can be summarized as follows (Mehrjerdi, 2010):

QFD can be used to-

- Help in making trade-offs between what the buyers' requirements and what the company can afford to produce;
- Enhance teamwork among the engineers in the department;
- Increase buyer satisfaction (this is done by taking buyers' requirements (CRs) into consideration and bringing them into the product development process);
- Shorten the time to market;
- Cause employees to make sufficient documentation because of seeing the importance of information; and
- Improve effective communication between company divisions.

QFD is also used for setting design requirements in the supply chain. For example, Sohn and Choi (2000) used the QFD model to systematically relate customer requirements with design requirements in each supply chain of product development. In this way, a number of authors deployed QFD in supply chain research for example, Bottani and Rizzi (2006); used QFD for meeting customers' requirement through improved logistics and supply chain management function. Pujawan and Geraldin (2006) used QFD for proactive supply chain risk management. Therefore, the QFD model can also be used to develop a sustainable supply chain model which can facilitate meeting the sustainability requirements of buyers to make RMG supply chain more sustainable. QFD, in this approach, will be applied as the main tool to address customers' requirements (CRs) and integrate those requirements into design requirements (DRs) to meet the sustainability requirements of buyers and stakeholders.

In QFD modelling, 'customer requirements' are referred as WHATs and 'how to fulfil the customer's requirements' are referred as HOWs. The process of using appropriate HOWs to meet the given WHATs is represented as a matrix. Different users build different QFD models involving different elements but the most simple and widely used QFD model contains at least the customer requirements (WHATs) and their relative importance, technical measures or design requirements (HOWs) and their relationships with the WHATs, and the importance ratings of the HOWs. Six sets of input information are required in a basic QFD model: (i) WHATs: attributes of the product as demanded by the customers, (ii) IMPORTANCE: relative importance of the above attributes as perceived by thecustomers, (iii) HOWs: design attributes of the product or the technical descriptors, (iv) Correlation Matrix 1: interrelationships among the design requirements, (v) Relationship Matrix: relationships between WHATs and HOWs (strong, medium or weak), and (vi) Competitive Assessment: assessment of customer satisfaction with the attributes of the product under consideration against the product produced by its competitor or the best manufacturer in the market (Mukherjee, 2011).

### 2.3 A Fuzzy QFD approach:

(Zadeh, 1965) was first who introduced the fuzzy set theory to deal the issue of ill-defined problems that encountered a certain level of uncertainty and vagueness. The prime advantage of using fuzzy logic is that it is amenable to express ill-defined judgments, such as the impact of how on what's. Further, the application of fuzzy numbers has become enormously important in the area of decision-making in which linguistic scales are adopted and specially, when a panel of decision makers (DMs) is involved in decision making process (Bottani and Rizzi, 2006). In this regard, subjective judgement of human being can be reproduced and fuzzy numbers make it possible to reproduce the typical subjective way of thinking of human beings (Bottani and Rizzi, 2006).

Choosing fuzzy logic as an aid to QFD methodology seems logical because fuzzy logic can deal with inexact information and linguistic data by using mathematical terms in a well-defined way (Hisdal, 1988). It represents the verbal data quantitatively in a precise manner which is free from vagueness and also free from response bias (Bottani and Rizzi, 2006); (Bevilacqua et al., 2006); (Lee and Kim, 2000). The ambiguity and imprecision in QFD may be because of laxity of formal mechanisms for translating WHATs (which are generally qualitative) into HOWs (usually quantitative). Usually it may have several WHATs for a how and each WHAT can be related to several HOWs. Usually, the WHATs are interpreted to HOWs in a subjective and qualitative way but it should be translated into more quantitative and technical manner which is responsible for ambiguous and imprecise relationships between WHATs and HOWs (Kim et al., 2000); (Bottani and Rizzi, 2006).

Research on fuzzy-QFD has made substantial progress(Bevilacqua et al., 2006)(Khoo and Ho, 1996) proposed that the ambiguity in QFD operations can be resolved by the application fuzzy numbers. (Wang, 1999) enumerated a fuzzy approach to prioritize HOWs. Researchers such as (Bevilacqua et al., 2006); (Bottani and Rizzi, 2006) used fuzzy QFD to overcome the ambiguity in traditional QFD method. In this paper we propose for the first time the fuzzy-QFD methodology for developing a sustainability model.

## 3. METHODOLOGY

This paper uses QFD approach and illustrates the HOQ following the approaches suggested by (Brown, 1991), and (Griffin and Hauser, 1993). In Step 1: we identify the sustainability requirements of the buyers (WHATs) by taking opinion from decision makers of two renowned garments manufacturers and one supplier. In step 2: we identify the ways to meet the sustainability requirements of the buyers (HOWs) by brain storming the respondents. This is also called the Engineering characteristics in preparing the HOQ matrix. Step 3: Preparation of the relationship matrix. Our respondents judge which WHATs impact which HOWs and to what degree and shown in matrix 1 (Table 3) and matrix 2 (Table 4). Step 4: Preparation of HOQ which is shown by figure-3. It consist of elaboration of the correlation matrix, calculation of relative importance of each how and determination of the physical relationships among the technical requirements are specified on an array known as ‘‘the roof matrix’’. The weights of the HOWs are placed at the base of the quality matrix. The importance (or weight) of each ‘‘WHAT’’ and “HOW” is based on linguistic variable. The linguistic variables were translated into fuzzy numbers by defining appropriate fitness functions. The triangular fuzzy numbers have been used to express data with respect to QFD approach in RMG supply chain sustainability of Bangladesh. Response from a group of decision maker will be collected to avoid the response bias and to reduce impact of the partiality in the decision process (Lee and Kim, 2000). The weights as per the opinion of the decision makers are aggregated through averaging the opinion scores.

### 3.1 Fuzzy Logic approach:

Fuzzy logic is based on fuzzy number groups or sets. The elements of a set are related to a value that indicates to what extent the element is a member of the set. This value may be within the range [0,1,2], where 0 represents minimum degree of membership whereas 1 and 2 represent partial membership and maximum degree of membership respectively. One may use different types of fuzzy number depending on the requirements and based on analysis of a given ambiguous structure. In this paper we use triangular fuzzy numbers which is called triplets. The triplets is in the form of A=(xL, xα , xR) where xL, xα and xRare in the membership group A. xL, and xR are the lower and upper limits of the fuzzy number, while xα is the element of closest fit. Triplets are often used to quantify linguistic data because this sort of triangular fuzzy numbers are easier than other fuzzy numbers to manage calculation (Bevilacqua et al., 2006). For example, suppose U= (VL, L, M, H, VH) is a linguistic set used to express opinions on a group of attributes. Where, VL = very low, L = low, M = medium, H = high, VH = very high. The linguistic variables under set U can be quantified using triangular fuzzy numbers as shown in Figure 2.

In Figure2, VL= (0,1,2); L= (2,3,4); M= (4,5,6); H= (6,7,8) and VH= (8,9,10).Here, the linguistic variable M, as an instance stands for decision maker's assessment of grades XL=4 up to a grade XR= 6, with a maximum degree of membership in xα= 5.

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### 3.2 Weighting the WHATs':

Each of the three decision-makers established the level of importance (or weight) of each ''what'' by means of a linguistic variable. Five different levels of importance were used in this study, i.e. very low, low, medium, high and very high, subsequently indicated as VL, L, M, H, VH. The outcome of this stage is shown in Table: 1 and 2. The linguistic variables were translated into triangular fuzzy numbers by defining appropriate fitness functions as mentioned earlier. In this paper the weights assigned by the decision-makers were aggregated using the average operator which is illustrated by the following equation:

$$Weight_{(What)} = \{W_i, \quad where i = 1, \ldots \ldots k\}$$

$$W_i = \frac{1}{n}\sum_{i=1}^{k} W_i$$

Where k represents the number of WHATs and n is the number of decision-makers. Thereby, K=9 and n=3 including all respondents (manufacturer and supplier). Each element on the Weight (what) vector is a triangular fuzzy number defined by the triplet Wi= $(W_{i\propto}, W_{i\beta}, W_{i\gamma})$ . The weights obtained by aggregating the opinions expressed by each decision maker are shown intable-1.

**3.3 Determining the "HOW" and "WHAT" correlation scores and weighting the 'HOWs':**

$$Rating = \{r_{ij}, \quad where i = 1, \ldots \ldots k and j = 1 \ldots \ldots m\}$$

$$r_{ij} = \frac{1}{n}\sum_{i=1}^{k}\sum_{j=1}^{m}(r_{ij})$$

Where, k= number of the WHATs, m=number of the HOWs and n= number of the decision-makers. In our case, k=9, m =7 and n= 3. In this case, the RATING is obtained from the matrix of the "HOW-WHAT'' correlation scores, in which rij elements represent an aggregate correlation score between the ith WHAT and the jth HOW. Here again, the rij elements are triangular fuzzy numbers defined by the triplets, $r_{ij} = (r_{ij\propto}, r_{ij\beta}, r_{ij\gamma})$.

The weights of HOW are calculated as follows:

$$\mathrm{Weight(How)_i} = \mathrm{V\,(How)_{i1}} \times \mathrm{imp\,(What_1)} + \ldots\ldots\ldots\ldots + \mathrm{V\,(How)_{in}} \times \mathrm{imp\,(What_1)}$$

Where $\mathrm{V(How)_{in}}$ = the correlation value of $\mathrm{How_i}$ with $\mathrm{What_n}$ and $\mathrm{imp\,(What_n)}$ denotes the importance or priority of $\mathrm{What_n}$.

By other means to calculate the weights of the "HOWs'', we can average the aggregate weighted rij correlation scores with the aggregate weights of the "WHATs" Wi following the equation:

$$\mathrm{Weight_{(How)}} = \{\mathrm{W_j}, \quad \text{where } \mathrm{j} = 1, \ldots \ldots \mathrm{k}\}$$

$$\mathrm{W_j} = \frac{1}{\mathrm{k}}\left[\left(\mathrm{r_{j1}} \times \mathrm{W_1}\right) + \ldots\ldots\ldots\ldots + \left(\mathrm{r_{jk}} \times \mathrm{W_k}\right)\right]$$

Where, k and m stand for the same term used above. Each Wj on the WEIGHTS (HOW) vector represents the weight of each attribute opined by the decision makers. The Wjs are, once again, triangular fuzzy numbers defined by the triplets$W_j = (W_{j\propto}, W_{j\beta}, W_{j\gamma})$. The fuzzy values for the weights of the ''HOWs'' are shown in the matrix-1.

The physical relationships among the technical requirements are specified on an array known as ''the roof matrix''. In the roof matrix four types of relation have been shown namely
strong, medium, weak and no relation.

√= Very strong relation

Δ= strong relation

O = medium relation

□= weak relation

×= no relation.

## 4. CASE STUDY

Bangladesh, a small country of south Asia, has gained substantial economic progress and considered one of the growth generating countries of the world. Along with the successes the country is still struggling for its poor socio political condition and lack of a sustainable development plan (Belal and Owen, 2007). Most of the companies are found to be failing to comply with the aspects of social and environmental issues (Naeem and Welford, 2009). Bangladeshi organizations are accused of existing poor working conditions, inadequate factory health and safety measures, violation of human rights, environmental pollution the use of child labour (Belal and Owen, 2007); (Islam and Deegan, 2008), (Naeem and Welford, 2009). Violation of Social and environmental issues are more vibrantly echoed in RMG industry, a highly labour intensive industry, of Bangladesh because of the nature of industry and its economic importance for the country. These issues are often highlighted in western media and create negative image of Bangladeshi products in the mind of consumers. As a result western buyers such as Wal-Mart, Kmart, GAAP and others buying the RMGs from Bangladesh are facing pressures from the consumers, NGOs as well as government agencies (Islam and Deegan, 2008). This sort of pressures has pulling effect. As a result the buyers are imposing compliance of social and environmental issues on the part of garments manufacturers. Thereby, the garment manufacturers need to meet the requirements and expectations with regards to social and environmental sustainability issues otherwise they do not get sales order from buyers. The prevalence of meeting buyers' sustainability expectations and existence of theoretical gap regarding identification and mitigation of sustainability requirements have motivated the researchers to conduct the study particularly, on RMG industry of Bangladesh.

The Fuzzy-QFD approach is applied to the research process and data were collected from two renowned RMG manufacturers and a supplier of Bangladesh. The data were collected from supply chain manager of all case companies by face to face interview and denoted as decision maker 1, 2 and 3.

### 4.1 Identifying the WHATs

1. Ensuring fair wages and payments (minimum wage standard, overtime payment, festival bonus, formal recruitment)
2. Ensuring leave benefits (weekly leave, maternity leave, seek leave, casual leave).
3. Ensuring health hazard and Safety factors (H & S factors for example cleanliness & sanitation, pure drinking water, fire safety equipment, Personal protective equipment, wider and sufficient exit, proper light, ventilation, dust control, temperature control)
4. Ensuring no child labour in organization (ensuring a minimum age of 18 during recruitment)
5. Ensuring no force labour and harassment (ensuring that workers shall not be compelled to work excessive hours and no harassment or misbehaviour)
6. Environment and health hazard free ingredient in product (EHHFIP, For example lead free, AZO free fabrics and sensitivity to metal, colour and banned chemical)
7. Adopting environment pollution controlling measures (EPCM, for example, controlling solid and chemical wastes).

### 4.2 Identifying the 'HOWs'

1. Human resource (HR) policy regarding workers benefits.
2. Organizational strategy, culture and awareness regarding sustainability
3. Setting Social and environmental compliance standard and having social and environmental compliance cell (SEC)
4. Monitoring and Auditing suppliers plants
5. Supplier evaluation, selection and development
6. Quality control and lab testing during receiving material and distribution of products.
7. Training and development and awareness building regarding sustainability (T&D)
8. Installing efficient machinery and technology (technology)
9. Recycling, reusing and treatment of wastes.

## 5. DISCUSSION AND FURTHER RESEARCH

In this paper, based on the interview with supply chain manager of case companies seven more common social and environmental sustainability requirements of buyers have been listed. For example, Ensuring fair wages and payments, ensuring leave benefits, and ensuring health hazard and Safety factors and others. Different buyers have different sustainability requirements but there are commonness among them regarding most important issues. However, among the more important and common requirements some are of high priority. Therefore, it is evident from table-1, that Environment and health hazard free ingredient (EHHFI), Child labour, Health hazard and Safety (H&S) and Fair wages & payments are the highly concerned issues. The correlation of buyers' sustainability requirements and corresponding sustainability design requirement is shown in matrix-1 and 2. Matrix-1 portrays that corresponding to the requirement of Ensuring fair wages and payments, sustainability design requirements such as Setting human resource (HR) policy regarding workers benefits (W1), and Setting social and environmental compliance standard and having social and environmental compliance cell (W3) are highly important. With respect to the requirement of Health hazard and safety, sustainability design requirements such as organizational strategy, culture and awareness regarding sustainability (W2), Setting social and environmental compliance standard and having social and environmental compliance cell (W3), monitoring & Auditing suppliers plants (W4) and Training and development and awareness building (W7) are more important. Similarly, In line with the buyers requirement of Ensuring no child labour in organization sustainability design requirement of Setting human resource (HR) policy regarding workers benefits (W1), Organizational strategy, culture and awareness regarding sustainability (W2), Setting social and environmental compliance standard and having social and environmental compliance cell (W3), Monitoring and Auditing suppliers plants (W4) and Supplier evaluation, selection & development (W5) are highly important. Finally, corresponding to the buyers requirement of Environment and health hazard free ingredient in product, the sustainability design requirement of Setting social and environmental compliance standard and having social and environmental compliance cell (W3), Supplier evaluation, selection and development (W5), Quality control and lab testing (W6) and training and development and awareness building (W7) are very important. Besides the corresponding sustainability design requirements to meet specific buyers requirements, Setting human resource (HR) policy regarding workers benefits (W1), Organizational strategy, culture and awareness regarding sustainability (W2) and Setting social and environmental compliance standard and having social and environmental compliance cell (W3) are considered as more important sustainability design requirements in general.

Developing and improving the sustainability design requirements as shown in house of sustainability (HOS) model (figure-3) will help to meet the sustainability requirements of buyers and thus assist in building customer satisfaction. Moreover, the roof matrix in the HOS shows that there is a very strong relation between setting HR policy regarding workers benefits (W1) and Organizational strategy, culture and awareness regarding sustainability (W2). The relation between Organizational strategy, culture and awareness regarding sustainability (W2) and setting Social and environmental compliance standard and having social and environmental compliance cell (W3), and monitoring and Auditing suppliers plants (W4) and supplier evaluation & selection (W5) is also very strong. Further, the relation between organizational strategy & culture for sustainability (W2) and efficient technology (W8) and recycling reusing & treatment of waste (W9) is very strong. This sort of very strong relation reveals that organizational strategy and awareness regarding sustainability is a very important means of meeting a number of sustainability design requirements. Thus, organizations and their supply chain shall highly emphasize on organizational strategy and awareness regarding sustainability. Organizations and their supply chains shall allocate budget based on the importance of the interrelation among the requirements such as development of sustainability awareness and setting organizational strategy in line with that.

However, how much cost and investment are involved in building the sustainability design requirements is to be analysed. It will be interesting if the further research digs deeper regarding analysis on cost and investment needed in building the sustainability design requirements. A further research may also be conducted by incorporating the sustainability requirements of all types of stakeholders rather than confining to only the buyers requirements.

## 6. CONCLUSION

There are a number of implications of this study. First, it identifies the salient sustainability requirements of the buyers. Second, it suggests corresponding sustainability design requirements to meet those requirements to develop a sustainable supply chain. Finally, it has an indication to conduct future research to dig deeper regarding cost and investment requirements for the design requirements. Based on the opinion of decision makers of the companies an illustrative empirical study has been drawn that identifies seven sustainability requirements of the buyers and nine design requirements to meet those requirements. It is found that the more important sustainability requirements of buyers are Environment and health hazard free ingredient (EHHFI), Child labour, Health hazard and Safety (H&S) and Fair wages & payments. Corresponding to the requirements the highly important design requirements are Setting Social and environmental compliance standard and human resource (HR) policy regarding workers benefits, Organizational strategy, culture and awareness regarding sustainability and social and environmental compliance cell. The house of quality for meeting sustainability requirements of the buyers presented in this paper is a unique and novel contribution for supply chain sustainability. As an illustration of the application we present a multiple case study on

Ready-made garment industry of Bangladesh. The HOQ framework can be implemented to similar type of labour intensive manufacturing organizations without much change needed. The procedure would still be the same, although the types of sustainability requirements and mitigation requirements may vary to some extent from case to case.

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**FIGURES AND TABLES**

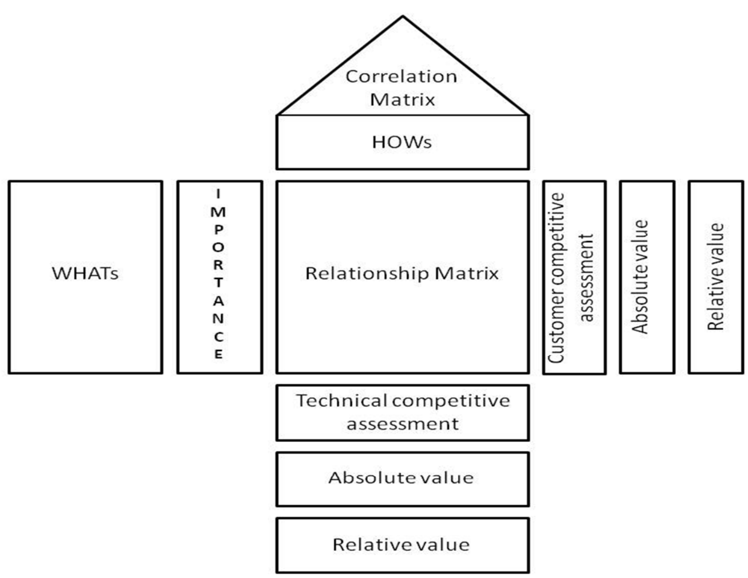


Figure 1: QFD model

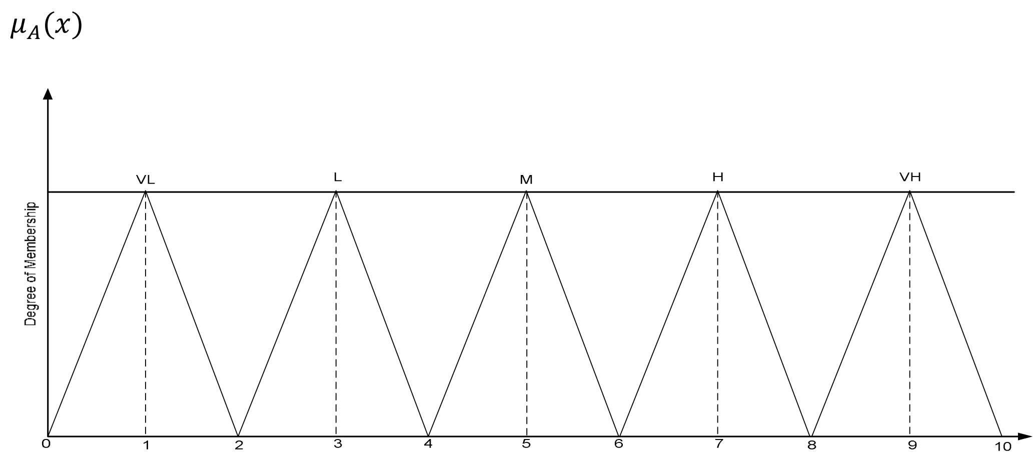



Figure 2: Linguistic scale for relative importance

### 4.3. Weights the WHATs':

| Whats | α | β | □ |
|---|---|---|---|
| Fair wages | 7.33 | 8.33 | 9.33 |
| Leave benefit | 6.67 | 7.67 | 8.67 |
| Health hazard and Safety (H&S) | 7.33 | 8.33 | 9.33 |
| No Child labour | 8 | 9 | 10 |
| No Force labour | 6.67 | 7.67 | 8.67 |
| Environment and health hazard free ingredient (EHHFI) | 8 | 9 | 10 |
| Environment pollution controlling measures (EPCM) | 6.67 | 7.67 | 8.67 |

Table 1: Aggregated weight of WHATS

| Whats | DM1 | DM2 | DM3 |
|---|---|---|---|
| Fair wages and payments | VH | VH | H |
| Leave benefits | H | VH | H |
| Health hazard and Safety (H&S) | VH | VH | H |
| Child labour | VH | VH | VH |
| Force labour | H | H | VH |
| Environment and health hazard free ingredient (EHHFI) | VH | VH | VH |
| Environment pollution controlling measures (EPCM) | H | V | H |

Table 2: Importance-of-WHATs

### 4.4 Determining the ‘HOW’-‘WHAT’ correlation scores and weighting the ‘HOWs’

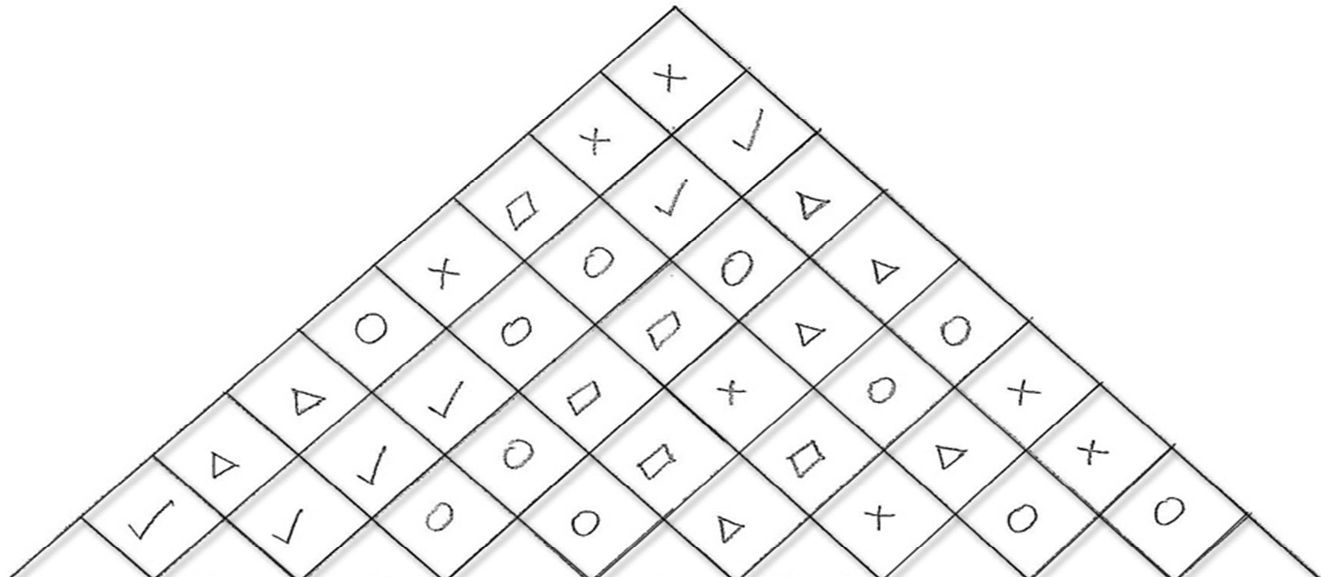
| HOWs | HR policy (W1) | | | Organizational strategy and awareness for sustainability (W2) | | | S & E compliance cell (W3) | | | Monitoring and auditing (W4) | | | Supplier evaluation and selection (W5) | | | Quality control and testing (W6) | | | Training and development (W7) | | | Efficient technology (W8) | | | Recycling, reusing and treatment of waste (W9) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | α | β | ϒ | α | β | ϒ | α | β | ϒ | α | β | ϒ | α | β | ϒ | α | β | ϒ | α | β | ϒ | α | β | ϒ | α | β | ϒ |
| Fair wages | 6.67 | 7.67 | 8.67 | 4.67 | 5.67 | 6.67 | 6.67 | 7.67 | 8.67 | 4.67 | 5.67 | 6.67 | 2.67 | 3.67 | 4.67 | 0.67 | 1.67 | 2.67 | 1.33 | 2.33 | 3.33 | 0.67 | 1.67 | 2.67 | 0.33 | 1.33 | 2.33 |
| Leave benefits | 6.33 | 8.33 | 9.33 | 4.67 | 5.67 | 6.67 | 4.67 | 5.67 | 6.67 | 4.67 | 5.67 | 6.67 | 2.67 | 3.67 | 4.67 | 0.67 | 1.67 | 2.67 | 0.67 | 1.67 | 2.67 | 0.67 | 1.67 | 2.67 | 0.33 | 1.33 | 2.33 |
| H& S | 4.67 | 5.67 | 6.67 | 5.33 | 6.33 | 7.33 | 7.33 | 8.33 | 9.33 | 5.33 | 6.33 | 7.33 | 4.67 | 5.67 | 6.67 | 2.67 | 3.67 | 4.67 | 6.67 | 7.67 | 8.67 | 3.33 | 4.33 | 5.33 | 0.67 | 1.67 | 2.67 |
| Child labour | 7.33 | 8.33 | 9.33 | 6.67 | 7.67 | 8.67 | 7.33 | 8.33 | 9.33 | 6.67 | 7.67 | 8.67 | 5.33 | 6.33 | 7.33 | 0.67 | 1.67 | 2.67 | 0.67 | 1.67 | 2.67 | 0.67 | 1.67 | 2.67 | 0.33 | 1.33 | 2.33 |
| Force labour | 5.33 | 6.33 | 7.33 | 4.67 | 5.67 | 6.67 | 5.33 | 6.33 | 7.33 | 3.33 | 4.33 | 5.33 | 2.67 | 3.67 | 4.67 | 0.67 | 1.67 | 2.67 | 0.67 | 1.67 | 2.67 | 0.67 | 1.67 | 2.67 | 0.33 | 1.33 | 2.33 |
| EHHFI | 2.67 | 3.67 | 4.67 | 3.33 | 4.33 | 5.33 | 5.33 | 6.33 | 7.33 | 4.67 | 5.67 | 6.67 | 5.33 | 6.33 | 7.33 | 7.33 | 8.33 | 9.33 | 5.33 | 6.33 | 7.33 | 4.67 | 5.67 | 6.67 | 0.67 | 1.67 | 2.67 |
| EPCM | 1.33 | 2.33 | 3.33 | 4.67 | 5.67 | 6.67 | 4.67 | 5.67 | 6.67 | 6.67 | 7.67 | 8.67 | 4.67 | 5.67 | 6.67 | 1.33 | 2.33 | 3.33 | 4.67 | 5.67 | 6.67 | 5.33 | 6.33 | 7.33 | 7.33 | 8.33 | 9.33 |
| **RI of HOWs** | **43.1** | **57.3** | **73.4** | **37.4** | **50.8** | **59.1** | **29.4** | **41.7** | **55.9** | **15.2** | **25.4** | **37.7** | **21** | **32.1** | **41.2** | **15.8** | **25.4** | **37.7** | **20.1** | **32.1** | **45.2** | **16.7** | **27.2** | **39.7** | **8.5** | **17.9** | **29.4** |

Note: R.I.= Relative importance.

Table 3: ‘HOW’-‘WHAT’ correlation scores and weighting the ‘HOWs

| | HR policy | | | Organizational strategy | | | S & E compliance cell | | | Monitoring and auditing | | | Supplier evaluation and | | | Quality control and | | | Training and | | | Efficient technology | | | ETP and WTP | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fair wages | H | H | VH | M | M | H | H | H | VH | M | M | H | L | L | M | VL | VL | L | VL | L | L | VL | VL | L | VL | VL | L |
| Leave benefits | H | VH | VH | M | M | H | M | M | H | M | M | H | L | L | M | VL | VL | L | VL | VL | L | VL | VL | L | VL | VL | L |
| H& S | M | M | H | M | H | H | H | VH | VH | M | M | H | M | M | H | L | L | M | H | H | VH | L | L | M | VL | VL | L |
| Child labour | H | VH | VH | H | H | VH | H | VH | VH | H | H | VH | M | H | H | VL | VL | L | VL | VL | L | VL | VL | L | VL | VL | L |
| Force labour | M | H | H | M | M | H | M | H | H | L | M | M | L | L | M | VL | VL | L | VL | VL | L | VL | VL | L | VL | VL | L |
| EHHFI | L | L | M | L | M | M | M | H | H | M | M | H | M | H | H | H | VH | VH | M | H | H | M | M | H | VL | VL | L |
| EPCM | VL | L | L | M | M | H | M | M | H | H | H | VH | M | M | H | VL | L | L | M | M | H | M | H | H | H | VH | VH |

Table 4: Respondents’ opinion for ‘HOW’-‘WHAT’ correlation



| Whats | α | β | □ |
|---|---|---|---|
| Fair wages | 7.33 | 8.33 | 9.33 |
| Leave benefit | 6.67 | 7.67 | 8.67 |
| H&S | 7.33 | 8.33 | 9.33 |
| No Child labour | 8 | 9 | 10 |
| No Force labour | 6.67 | 7.67 | 8.67 |
| EHHFI) | 8 | 9 | 10 |
| EPCM | 6.67 | 7.67 | 8.67 |

| HR policy (W1) | | | Organizational strategy and awareness for sustainability (W2) | | | S & E compliance cell (W3) | | |
|---|---|---|---|---|---|---|---|---|
| α | β | ϒ | α | β | ϒ | α | β | ϒ |
| 6.67 | 7.67 | 8.67 | 4.67 | 5.67 | 6.67 | 6.67 | 7.67 | 8.67 |
| 6.33 | 8.33 | 9.33 | 4.67 | 5.67 | 6.67 | 4.67 | 5.67 | 6.67 |
| 4.67 | 5.67 | 6.67 | 5.33 | 6.33 | 7.33 | 7.33 | 8.33 | 9.33 |
| 7.33 | 8.33 | 9.33 | 6.67 | 7.67 | 8.67 | 7.33 | 8.33 | 9.33 |
| 5.33 | 6.33 | 7.33 | 4.67 | 5.67 | 6.67 | 5.33 | 6.33 | 7.33 |
| 2.67 | 3.67 | 4.67 | 3.33 | 4.33 | 5.33 | 5.33 | 6.33 | 7.33 |
| 1.33 | 2.33 | 3.33 | 4.67 | 5.67 | 6.67 | 4.67 | 5.67 | 6.67 |
| 43.1 | 57.3 | 73.4 | 37.4 | 50.8 | 59.1 | 29.4 | 41.7 | 55.9 |

| Monitoring and auditing (W4) | | | Supplier evaluation and selection (W5) | | | Quality control and testing (W6) | | |
|---|---|---|---|---|---|---|---|---|
| α | β | ϒ | α | β | ϒ | α | β | ϒ |
| 4.67 | 5.67 | 6.67 | 2.67 | 3.67 | 4.67 | 0.67 | 1.67 | 2.67 |
| 4.67 | 5.67 | 6.67 | 2.67 | 3.67 | 4.67 | 0.67 | 1.67 | 2.67 |
| 5.33 | 6.33 | 7.33 | 4.67 | 5.67 | 6.67 | 2.67 | 3.67 | 4.67 |
| 6.67 | 7.67 | 8.67 | 5.33 | 6.33 | 7.33 | 0.67 | 1.67 | 2.67 |
| 3.33 | 4.33 | 5.33 | 2.67 | 3.67 | 4.67 | 0.67 | 1.67 | 2.67 |
| 4.67 | 5.67 | 6.67 | 5.33 | 6.33 | 7.33 | 7.33 | 8.33 | 9.33 |
| 6.67 | 7.67 | 8.67 | 4.67 | 5.67 | 6.67 | 1.33 | 2.33 | 3.33 |
| 15.2 | 25.4 | 37.7 | 21 | 32.1 | 41.2 | 15.8 | 25.4 | 37.7 |

| Training and development (W7) | | | Efficient technology (W8) | | | Recycling, reusing and treatment of waste (W9) | | |
|---|---|---|---|---|---|---|---|---|
| α | β | ϒ | α | β | ϒ | α | β | ϒ |
| 1.33 | 2.33 | 3.33 | 0.67 | 1.67 | 2.67 | 0.33 | 1.33 | 2.33 |
| 0.67 | 1.67 | 2.67 | 0.67 | 1.67 | 2.67 | 0.33 | 1.33 | 2.33 |
| 6.67 | 7.67 | 8.67 | 3.33 | 4.33 | 5.33 | 0.67 | 1.67 | 2.67 |
| 0.67 | 1.67 | 2.67 | 0.67 | 1.67 | 2.67 | 0.33 | 1.33 | 2.33 |
| 0.67 | 1.67 | 2.67 | 0.67 | 1.67 | 2.67 | 0.33 | 1.33 | 2.33 |
| 5.33 | 6.33 | 7.33 | 4.67 | 5.67 | 6.67 | 0.67 | 1.67 | 2.67 |
| 4.67 | 5.67 | 6.67 | 5.33 | 6.33 | 7.33 | 7.33 | 8.33 | 9.33 |
| 20.1 | 32.1 | 45.2 | 16.7 | 27.2 | 39.7 | 8.5 | 17.9 | 29.4 |

Figure 3: House of sustainability (HOS)