Fuzzy AHP-based Study of Barriers to the Implementation of Cleaner Production in Textile Industry

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Abstract

Cleaner production (CP) approaches and technologies are top-tier tools to align with sustainable innovation policies and furthermore, governments of the developing countries have become mindful about sustainable strategies to prevent pollution in recent years. However, only a handful of organizations in textile industry in developing countries have embraced CP approaches throughout the years. Therefore, this paper has shortlisted 20 barriers among all using previous literature, expert opinion and assessment of the entire stakeholders chain from the perspective of textile industries operating in developing countries which fall under 4 major criteria: i) Technologic and Information barrier, ii) Economic and Financial barrier, iii) Market barrier, iv) Managerial barrier. Fuzzy Analytic Hierarchy Process (FAHP) which is an excellent tool to deal with linguistic level of comparisons, has been used to rank these barriers to set spotlight on the most critical group of barriers. The outcome of this paper will act as spur to set sustainable strategies and goal against them while having limited resource. Finally, this paper stands out as it focuses on the proactive step to ease the application of CP approaches on textile industry which accompany high environmental expense in terms of dumping the untreated waste water into water bodies.

Keywords:

Cleaner Production, Pollution Prevention, Fuzzy Analytic Hierarchy Process, Textile Industry.

1. Introduction

Cleaner Production (CP) is a concept that deals with utilizing the limited energy sources and materials used in production efficiently and efficaciously as well as superseding the detrimental and virulent materials by materials that are considered to be anodyne (Hens et al., 2018). The proper implementation of CP is consummated through diminishing the misuse of raw materials and natural resources alongside a warranted utilization of energy, a significant reduction in harmful emissions and wastes, and increasing the percentage of recycling (Basappaji & Nagesha, 2014). This concept of preventive strategy has become more desideratum nowadays as the world is seeing an unprecedented escalation in industrialization followed by an uncontrolled rate of urbanization and population boom. This implies the need for an humungous amount of energy and materials to meet the ever increasing demand of the inhabitants of this planet which in turn is achieved through exploitation and deterioration of the environment (Severo et al, 2017).

It is now recognized and substantiated that practices of CP entrench a higher profit margin in all sorts of industries in addition to providing competitive advantages to them (Jia et al., 2014; Khalili et al., 2015). Every industry in the developed countries has implemented the principles of CP and harvesting the benefits from it. However, the concepts and practices of CP are yet to be popularized among developing countries especially, one like Bangladesh. Among the different industries, the textile industry is one of the immensely important sectors in this country (Islam et al., 2011). This industry is involved in employing about 65% of population currently engaged in industries. Moreover, the lion's share of the export earnings, currently more than 81%, comes from this industry ("Bangladesh Textile Industry: Present Scenario, Future Prospects and Challenges," 2017). Therefore, it can be averred without any doubt that implementation of CP practices in this industry will be far more viable and profitable (de Oliveira Neto et al, 2019). However, the barriers responsible for encumbering the application of CP are to be identified and obviated beforehand. At present, the textile industry of this country is being hamstrung by many challenges such as, government restrictions, environmental policies, frequent accidents and death of the labors, riots, strikes and so on (Hossan et al., 2012; Kurpad, 2014). In these unpropitious conditions, implementing the principles of CP through a rigorous eradication of the liable barriers at first can give a massive boost in the profit generation as well as pollution and wastage minimization in this sector (Shi et al., 2008).

In this research work, the barriers to the execution and practice of CP in the textile industry of Bangladesh have been revealed and classified into four major criteria and each of them further classified into 5 sub criteria with the help of extant literature and experts in the relevant field of textile sector and subsequently, fuzzy AHP is applied to analyze and finally prioritize these existing barriers. The outcome of this work should have climacteric managerial implications in addition to a significant increase in the profit generation and pollution prevention in this vital sector of the country.

2. Literature Review

In this 21st century, people have become more concerned and vigilant for the environmental issues like global warming, climate change, ozone depletion etc. As a result, there have been new adjustments and adaptations towards establishment of eco-friendly technologies and operations in the industries to achieve a sustainable growth minimizing wastage and harmful emissions (Basappaji & Nagesha, 2014). These recent apprehensions for the environment have elicited green practices in developing new product that discourage the use of non-renewable energies, mitigate wastage through recycling and reuse and thus create a less deleterious effect on the nature (Casamayor & Su, 2013; Kuo et al., 2016). With this view in mind, numerous works related to CP are already available in the existing literature.

Severo et al. (2017) worked on the implementation of CP as well as environmental management (EM) for achieving sustainability in the industries of Brazil whereas the work of Mitchell (2006) deals with determining the barriers the hindered the execution of CP in Vietnam. Another work by Fang & Côté (2005) involved a discussion on not only the barriers but also the strategies and objectives of implementing CP in China. In a further study, CP approaches and practices in Turkey was explored (Yüksel, 2008). The aforementioned studies encompasses the implementation of CP covering an entire country. There are also an adequate number of literature where practices of CP in a specific and distinct industry are discussed. Such instances include an assessment of CP status in agro industries (Basappaji & Nagesha, 2014), a methodology to subjugate the barriers to CP in the small and medium sized companies in Brazil (Oliveira Neto et al., 2017), an evaluation of CP in vanadium extraction industry (Jia et al., 2014) and aviation industry (Peng & Li, 2011), an assessment of the criteria to implement CP successfully in the printed wiring board manufacturing industries in Taiwan (Tseng et al., 2009), and an application of CP concepts in the foundry industry (Fore & Mbohwa, 2010). Despite the innumerous application and implementation of CP in various industries all over the globe, researches on the CP practices in the textile industry are mere. The work by de Oliveira Neto et al. (2019) contributes in the current literature by assessing the benefits obtained from utilizing the principles of CP in textile industry of Brazil. Similar work by Ozturk et al. (2016) estimated a significant reduction of energy and materials consumption besides lowering the amount of harmful emissions in the textile mills in future after the implementation of 22 techniques relating to CP.

However, there is hardly any evidence on the presence of researches that encompass and encourage the enactment of CP in the textile industries of Bangladesh. As mentioned earlier, implementing CP can create a conspicuous difference in the industries of a progressing nation like Bangladesh. Since the textile sector is involved in gaining a large percentage of export earnings and GDP and also facing byzantine issues relating to environment pollution and government policies, implementing CP practices in this sector can tremendously enhance the economy and ensure environmental sustainability of this nation. With a view to establishing CP acts in textile industry, the potential barriers inherent in this industry's structure are first identified with the help of existing literature and consulting with the incumbents working at different positions of various textile companies. The identified barriers are divided into four major types. The list of these barriers are presented in Fig 1.

3. Solution Methodology

AHP, developed by Saaty in 1971 is a widely known tool for multi-criteria or attribute decision making which is based on algebraic assumption for prioritizing independent and hierarchical attributes. Later, Fuzzy AHP method has been established which is capable of handling uncertainty as linguistic scale is often ambiguous and difficult to express through sharp numbers as fuzzy set theory stands out in equivocal scenario. Among many options, triangular function has been chosen to determine the priority of both major criteria and their subcategories over one another. Through calculating pairwise comparison, synthetic extent analysis has been applied to convert the fuzzy triangular numbers into priority weights.

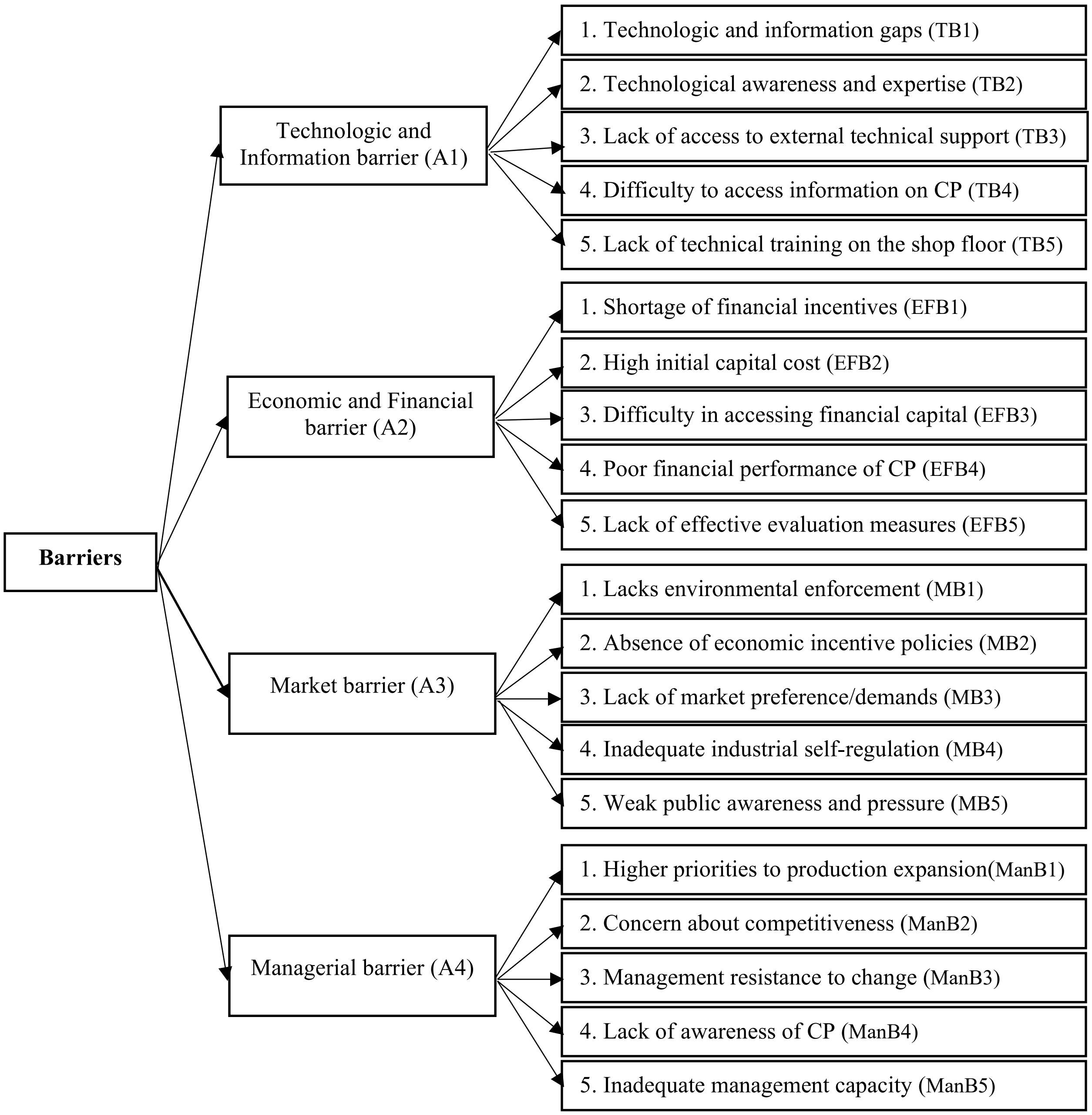

Figure 1. Identification and hierarchy of barriers under four major criteria

The methodology of the proposed model can be summarize through the following steps.

Step 1: Identification of factors through establishing expert group

In this step, a decision group consist of experts (both academics and practitioners) has to be selected to take opinions for both data entry or shortlisting factors. Questionnaire to collect these data has been made with linguistic options.

Step 2: Establish hierarchical structure

After identifying the factors through extensive literature review and further shortlisting them by expert opinion, a hierarchy with a goal which branches into levels and sublevel has to be established.

Step 3: Defining fuzzy triangular scale of relative importance

In this study, the triangular fuzzy numbers (TFN), $\tilde{1}$to$\tilde{9}$, have been used to replace conventional scaling points to take the uncertainty into consideration. As the qualitative assessment is replaced with numerical value, the five TFN ($\tilde{1}, \tilde{3}, \tilde{5}, \tilde{7}, \tilde{9}$) are defined instead of sharp numbers to handle the imprecision. All these alternatives are linguistically listed in Table-1.

Table 1. Linguistic variable to triangular fuzzy conversion scale

Linguistic scale	**Fuzzy numbers**	**Triangular fuzzy scale**	**Triangular fuzzy reciprocal scale**
Just equal	$\tilde{1}$	(1,1,1)	(1,1,1)
Equally important	$\tilde{1}$	(1,1,3)	(1/3,1,1)
Weakly important	$\tilde{3}$	(1,3,5)	(1/5,1/3,1)
Strongly important	$\tilde{5}$	(3,5,7)	(1/7,1/5,1/3)
Very strongly important	$\tilde{7}$	(5,7,9)	(1/9,1/7,1/5)
Extremely Preferred	$\tilde{9}$	(7,9,9)	(1/9,1/9,1/7)

Step 4: Establishing the pairwise comparison matrix

Fuzzy pairwise comparison matrix is established for all criteria and sub-criteria for further approach. If factor i has fuzzy triangular numbers assigned to it when compared to factor j, then j has the reciprocal of the aforementioned value when compared to i.

Step 5: Evaluate consistency ratio

Consistency ratio for each matrix is evaluated to check the overall consistency of the model where the following equations are used to determine the largest Eigen value, consistency index and consistency ratio respectively.

$$Aw = \lambda_{max} w \tag{1}$$

Where principle Eigen vector of the pairwise comparison matrix is denoted by w.

$$CI = \frac{\lambda_{max} - n}{n-1} \tag{2}$$

Where n is the matrix size.

$$CR = \frac{CI}{RI} \tag{3}$$

Where RI is random index number determined from Table-2.

The pairwise comparison matrix will be accepted only if $CR < 0.1$, otherwise it will have to go through further revise.

Table2. Random index for different matrix size

Size (n)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
RI	0	0	0.52	0.9	1.12	1.25	1.35	1.40

Step 6: Calculation of priority weights at different level of hierarchy

The allocated triangular fuzzy numbers into the pairwise comparison matrix can be expressed as $M_{gi}^{j}(i = 1,2,3, \dots\dots, n; j = 1,2,3, \dots\dots, m)$ with the parameter a, b and c. So, the value of fuzzy synthetic extent can be determined using equation (1).

$$S_i = \sum_{j=1}^{m} M_{gi}^{j} \times \left[\sum_{i=1}^{n} \sum_{j=1}^{m} M_{gi}^{j} \right]^{-1} \tag{4}$$

Fuzzy addition is adopted to determine the value of $\sum_{j=1}^{m} M_{gi}^{j}$ which has been shown in equation (2).

$$\sum_{j=1}^{m} M_{gi}^{j} = \left(\sum_{j=1}^{m} aj, \sum_{j=1}^{m} bj, \sum_{j=1}^{m} cj \right), \quad (i = 1,2,3, \dots \dots \dots, n) \tag{5}$$

Using equation 4 and 5, fuzzy relative weights for each criteria can be determined.

Step 7: Synthetic extent analysis of the fuzzy relative weights

The degree of possibility of $M_2 \geq M_1$can be defined as,

$$V(M_2 \geq M_1) = sup \left[min \left(\mu_{M_1}(x), \mu_{M_2}(x) \right) \right] \tag{6}$$

where, $M_2 = \left(a_2, b_{2,}c_2\right)$ and $M_1 = \left(a_1, b_{1,}c_1\right)$.

This can be expressed as,

$$V(\widetilde{M_2} \geq \widetilde{M_1}) = hgt(\widetilde{M_1} \cap \widetilde{M_2}) = \begin{cases} 1, & b_2 > b_1 \\ 0, & a_1 > c_2 \\ \dfrac{a_1 - c_2}{(b_2 - c_2) - (b_1 - a_1)}, & \text{otherwise} \end{cases} \tag{7}$$

From equation 6 it can be inferred that the highest intersection point between the criteria is necessary to compare M_1 and M_2. Later, the degree of possibility of a convex fuzzy number greater than all the other numbers compared with can be evaluated by the following equation.

$$\begin{aligned} V(M \geq M_1, M_2, M_3, \dots \dots \dots \dots, M_k) \\ &= V[(M \geq M_1) \text{and } (M \geq M_2) \text{ and } (M \geq M_3) \dots \dots \dots \dots \text{and } (M \geq M_k)\ ] \\ &= minV(M \geq M_i) \end{aligned} \tag{8}$$

where, $i = 1,2,3 \dots \dots \dots \dots k$

Step8: Normalization of weight

In this step, the relative weight of each matrix is normalized and also, the global weight can be evaluated simply multiplying the relative weights of major criteria with the corresponding relative weights of sub criteria.

4. Case Study

4.1 Identifying the barriers and structuring a hierarchy model

After identifying all possible barriers of cleaner production, only 20 among them have been selected through survey which align with the perspective of textile industry in Bangladesh. Using this data, a tree hierarchy has been built up where all these barriers fall under four major criteria (shown in figure 1).

4.2 Developing questionnaire and collecting expert opinion

Linguistic scale has been used to collect data about the priority in the comparison matrix from three expert (one academic, and two practitioners). Later, these responses has been converted to triangular fuzzy scale using table 2. If the criteria in row is more important, it is replaced by triangular fuzzy scale, otherwise the reciprocal scale is used.

4.3 Fuzzy evaluation of criteria

In this step, fuzzy comparison matrix for each criteria is constructed among its sub category. Fuzzy pairwise comparison matrix of major criteria and their subcategories has been shown in Tables 3-7.

Table 3. Pairwise comparison matrix of the major criteria

Attributes	A1	A2	A3	A4
A1	(1,1,1)	(1,5/3,11/3)	(5/3,11/3,17/3)	(1/7,1/5,1/3)
A2	(3/11,3/5,1)	(1,1,1)	(3/7,3/5,1)	(1/5,1/3,1)
A3	(3/17,3/11,3/5)	(1,5/3,7/3)	(1,1,1)	(3/23,3/17,3/11)
A4	(3,5,7)	(1,3,5)	(11/3,17/3,23/3)	(1,1,1)

Table 4. Pairwise comparison matrix of technologic and information barrier

Attributes	TB1	TB2	TB3	TB4	TB5
TB1	(1,1,1)	(3/17,3/11,3/5)	(1,7/3,13/3)	(1/7,1/5,1/3)	(1,7/3,13/3)
TB2	(5/3,11/3,17/3)	(1,1,1)	(11/3,17/3,23/3)	(3/7,3/13,1)	(13/3,19/3,25/3)
TB3	(3/13,3/7,1)	(3/23,3/17,3/11)	(1,1,1)	(1/5,1/3,1)	(1/3,1,1)
TB4	(3,5,7)	(1,13/3,7/3)	(1,3,5)	(1,1,1)	(3,5,7)
TB5	(3/13,3/7,1)	(3/25,3/19,3/13)	(1,1,3)	(1/7,1/5,1/3)	(1,1,1)

Table 5. Pairwise comparison matrix of economic and financial barrier

Attributes	EFB1	EFB2	EFB3	EFB4	EFB5
EFB1	(1,1,1)	(1/5,1/3,1)	(3/11,3/5,1)	(3/11,3/17,3/25)	(3/11,3/17,3/25)
EFB2	(5/3,11/3,17/3)	(1,1,1)	(1,7/3,13/3)	(1/5,1/3,1)	(1/5,1/3,1)
EFB3	(3/13,3/7,1)	(3/25,3/19,3/13)	(1,1,1)	(1/5,1/3,1)	(1/7,1/5,1/3)
EFB4	(3,5,7)	(1,13/3,7/3)	(1,3,5)	(1,1,1)	(1/5,1/3,1)
EFB5	(3/13,3/7,1)	(3/25,3/19,3/13)	(1,1,3)	(1/7,1/5,1/3)	(1,1,1)

Table 6. Pairwise comparison matrix of market barrier

Attributes	MB1	MB2	MB3	MB4	MB5
MB1	(1,1,1)	(1/5,1/3,1)	(1,7/3,13/3)	(13/3,19/3,25/3)	(1,5/3,11/3)
MB2	(1,3,5)	(1,1,1)	(5/3,11/3,17/3)	(7/3,13/3,19/3)	(5/3,11/3,17/3)
MB3	(3/13,3/7,1)	(3/5,3/11,3/17)	(1,1,1)	(1,7/3,13/3)	(1,5/3,11/3)
MB4	(3/25,3/19,3/13)	(3/19,3/13,3/7)	(3/13,3/7,1)	(1,1,1)	(1/7,1/5,1/3)
MB5	(3/11,3/5,1)	(3/17,3/11,3/5)	(3/11,3/5,1)	(3,5,7)	(1,1,1)

Table 7. Pairwise comparison matrix of managerial barrier

Attributes	ManB1	ManB2	ManB3	ManB4	ManB5
ManB1	(1,1,1)	(1/5,1/3,1)	(3/13,3/7,1)	(1/7,1/5,1/3)	(1,5/3,11/3)
ManB2	(1,3,5)	(1,1,1)	(1/5,3/5,1)	(1/7,1/5,1/3)	(1,7/3,13/3)
ManB3	(1,7/3,13/3)	(1,5/3,5)	(1,1,1)	(1/5,1/3,1)	(5/3,11/3,17/3)
ManB4	(3,5,7)	(3,5,7)	(1,3,5)	(1,1,1)	(3,5,7)
ManB5	(3/11,3/5,1)	(3/13,3/7,1)	(3/17,3/11,3/5)	(1/7,1/5,1/3)	(1,1,1)

Consistency ratio of each matrix has been determined using the equation 1, 2 and 3 and the value below 0.1 proved the consistency of the matrix.(shown in Table 8).Later, using equation 4 and 5, the value of fuzzy synthetic extent of each criteria and sub criteria has been determined and a sample has been shown in Table 9.

Table 8. CR of the pairwise comparison matrix

Matrix	Major Criteria	Technologic and Information Barriers	Economic and Financial Barrier	Market Barrier	Managerial Barrier
CR	0.0036	0.0874	0.0810	0.0826	0.0727

Table 9. Determination of the value of fuzzy synthetic extent of market barrier

Attributes	MB1	MB2	MB3	MB4	MB5	$\sum_{j=1}^{m} M_{gi}^{j}$	S_i
MB1	(1,1,1)	(1/5,1/3,1)	(1,7/3,13/3)	(13/3,19/3,25/3)	(1,5/3,11/3)	(7.53,11.67,18.33)	(0.11,0.27,0.73)
MB2	(1,3,5)	(1,1,1)	(5/3,11/3,17/3)	(7/3,13/3,19/3)	(5/3,11/3,17/3)	(7.67,15.67,23.67)	(0.12,0.37,0.95)
MB3	(3/13,3/7,1)	(3/5,3/11,3/17)	(1,1,1)	(1,7/3,13/3)	(1,5/3,11/3)	(3.41,5.70,10.60)	(0.05,0.13,0.42)
MB4	(3/25,3/19,3/13)	(3/19,3/13,3/7)	(3/13,3/7,1)	(1,1,1)	(1/7,1/5,1/3)	(1.65,2.02,2.99)	(0.02,0.05,0.12)
MB5	(3/11,3/5,1)	(3/17,3/11,3/5)	(3/11,3/5,1)	(3,5,7)	(1,1,1)	(4.72,7.47,10.60)	(0.07,0.18,0.42)

4.4 Applying synthetic extent evaluation

From the data shown in Table 8, the degree of possibility of superiority of S_{MB1} can be calculated and denoted by V ($S_{MB1} \geq S_{MB2}$) using equation 6 and 7. So, the degree of possibility of superiority for the first requirement-

$V(S_{MB1} \geq S_{MB2}) = 0.88$, $V(S_{MB1} \geq S_{MB4}) = 1$,

$V(S_{MB1} \geq S_{MB3}) = 1$, $V(S_{MB1} \geq S_{MB5}) = 1$,

Similarly, the degree of possibility of superiority for the second requirement-

$V(S_{MB2} \geq S_{MB1}) = 1$, $V(S_{MB2} \geq S_{MB4}) = 1$,

$V(S_{MB2} \geq S_{MB3}) = 1$, $V(S_{MB2} \geq S_{MB5}) = 1$,

The degree of possibility of superiority for the third requirement-

$V(S_{MB3} \geq S_{MB1}) = 0.69$, $V(S_{MB3} \geq S_{MB4}) = 1$,

$V(S_{MB3} \geq S_{MB2}) = 0.57$, $V(S_{MB3} \geq S_{MB5}) = 0.89$,

The degree of possibility of superiority for the fourth requirement-

$V(S_{MB4} \geq S_{MB1}) = 0.03$, $V(S_{MB4} \geq S_{MB3}) = 0.44$,

$V(S_{MB4} \geq S_{MB2}) = 0.01$, $V(S_{MB4} \geq S_{MB5}) = 0.27$,

The degree of possibility of superiority for the fifth requirement-

$V(S_{MB5} \geq S_{MB1}) = 0.76$, $V(S_{MB5} \geq S_{MB3}) = 1$,

$V(S_{MB5} \geq S_{MB2}) = 0.62$, $V(S_{MB5} \geq S_{MB4}) = 1$,

The minimum degree of possibility of superiority of each criterion over another is taken as the weight of that criterion and further normalized to get the final weight (equation 8). The weight vector and normalized weight vector of market barriers are respectively shown below.

$W = (0.88,1,0.57,0.01,0.62)$
$W' = (0.283,0.326,0.186,0.004,0.201)$

4.5 Determining global weight

After calculating the relative weight for each criterion, global weight has been determined by multiplying each relative weight of sub category with its respective relative weight of major criteria, to compare the priority of the barriers all together (Table-10).

Table 10. Weights and ranking of major criteria and sub-categories

Major Criterion	Relative Weights	Relative Rank	Sub-category	Relative weight	Relative Rank	Global Weight	Global rank
Technologic and Information barrier (A1)	0.3427	2	TB1	0.1898	3	0.06506	6
			TB2	0.3806	1	0.13043	3
			TB3	0.0049	5	0.00167	17
			TB4	0.3493	2	0.11970	5
			TB5	0.0754	4	0.02582	8
Economic and Financial barrier (A2)	0.0257	4	EFB1	0.0073	5	0.00019	19
			EFB2	0.2144	3	0.00550	15
			EFB3	0.1132	4	0.00290	16
			EFB4	0.3089	2	0.00793	13
			EFB5	0.3561	1	0.00914	11
Market barrier (A3)	0.0419	3	MB1	0.2833	2	0.01187	10
			MB2	0.3264	1	0.01368	9
			MB3	0.1855	4	0.00777	14
			MB4	0.0040	5	0.00017	20
			MB5	0.2009	3	0.00842	12
Managerial barrier (A4)	0.5898	1	ManB1	0.1045	4	0.06165	7
			ManB2	0.2140	3	0.12619	4
			ManB3	0.2791	2	0.16460	2
			ManB4	0.4010	1	0.23647	1
			ManB5	0.0015	5	0.00086	18

5. Result Analysis

In this research, both relative and global weight of each barriers identified to impede the cleaner production have been determined. From the final ranking of major criteria, managerial barriers has been observed to gain the highest weight since this study has been done on the textile industry of Bangladesh. From the perspective of developing countries, most of the organizations focus more on improving the bottom line rather than the social responsibility. Also, the myopic decision makers are unable to foresee the future boost in profit section by adopting cleaner production. The second most critical major criteria is technologic and information barrier. As a developing country, Bangladesh is also lagging in technologic advancement even though the government has undertaken manifold projects regarding this issue recently. Still, this criteria is considered as one of the major barrier to implement cleaner production. Market barrier comes as third in the priority list as the environmental rules and regulations in the developing countries are overlooked most of the times even by the government authority. As a result, industries as textile and leather, which are more likely to produce toxic industrial waste, take the advantage of these loophole to earn the short term profit neglecting the social responsibility. Economic and financial barrier come as the last one in priority list as the cleaner production is the major leap the organization has to take, and financial aid will be the last thing they will need to bring the changes.

According to the global rank, top 5 barriers can be marked as the most critical ones among the 20 barriers. Even though managerial barrier criteria tops in the major criteria priority list, it would be imprudent decision to focus on that branch which includes 5 sub categories. Rather, the top 5 barriers of the global rank, which are the subcategories of different major criteria should be focused to make the best utilization of allocated resource and effort. Lack of awareness of CP (ManB4) has been identified as the most critical barrier among all as it has the largest weight. This fall under the branch of managerial barrier which can be inferred as the lack of awareness among the decision makers about implementing CP. Textile industries in the developing countries like Bangladesh are more dependent on export earnings and they can hardly presentiment the long term benefits of implementing CP. Also, the professional in this sector of Bangladesh are more likely to emphasize on profit margin rather than funding the research and development department. So, this is the most critical impediment as it would not be hard to realize how this barrier is impeding the initiation of adopting CP measures.

Management resistance to change (ManB3), technological awareness and expertise (TB2), concern about competitiveness (ManB2) and difficulty to access information on CP (TB4) took the second, third, fourth and fifth position respectively in the global rank. Management which shows resistance to change as it may include risks and does not encourage flexibility and innovation, also shows indifference to social responsibilities are greatly impeding the CP implementation across the country. Since, most of the textile factories are using age old technologies and process in conventional way, implementing the CP tools will require the flexibility to changes and new adoption. Technological awareness and expertise is a big issue for developing countries though the government has started to invest for technological advancement, but this barrier becomes redundant from the developed countries perspective. Also, the managers and the decision makers are more concerned about competitiveness in price setting and unaware of the economic and environmental benefits of implementing CP. Also, most of the company in textile industry of Bangladesh are small and medium sized enterprise which face difficulty to access information on CP. Using the aforementioned global rank list obtained from the research, critical managerial decisions regarding CP implementation can be made to be proactive about the impeding factors and overall process improvement.

6. Conclusion

This research outcome can help the organization to set focus on pivotal area to align strategies with the sustainable goals and strategies. In most of the developing country, organizations deal with scant resource, goes along with the conventional process and hardly thinks about bringing any changes. While applying cleaner production in such organization, a manifold barriers can come across to impede even the initiation. However, it is not possible to allocate same amount of resource and attention to each one of them. So, the outcome of this research can help the decision makers narrow down the list. Fuzzy AHP method has helped to identify the most critical to least critical factor among the selected 20 and also allowed both local and global improvement according to necessity. Also, practitioners and experts are more comfortable to give their opinion in linguistic approach rather than sharp numbers and to deal with this uncertain and ambiguous data, fuzzy approach has been adopted.

Since this paper focused on the implementation of CP in textile industries of Bangladesh, government legislation has not been taken into consideration as the government has taken steps to encourage the organizations including SME to adopt greener approach and tightened up the environmental regulations. But the organizations which are adopting CP because of the government legislation have myopic view of possible obstruction that are impeding the whole process severely. So, this paper aims to contribute in this process through helping the managers being proactive about the potential critical barriers and allocate resource and effort to them to get the maximum output.

Acknowledgements

The authors express gratitude to the Department of Industrial and Production Engineering, Bangladesh University of Engineering and Technology (BUET) for all the efforts and cooperation to complete the research and to the industrial experts to response to the questionnaire. The authors are responsible for any remaining errors.

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