Prioritizing Fire Risk Criteria in Ready-Made Garments Factories of Bangladesh by Applying CRITIC Method

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Abstract

The ready-made garments (RMG) industry of Bangladesh is one of the renowned export-oriented garment industries in the world. Several hazardous fire incidents at RMG factories in recent decades became a matter of concern for national and international policymakers as well as stakeholders. Therefore, this study has been conducted to determine a prioritizing order of the fire risk factors of the RMG industry to assist decision-makers while implementing mitigation strategies. For this study, fire risk factors have been clustered into six criteria- causative factors, fire separation, egress obstruction, fire detection, fire protection, and egress lighting. Then the fire safety inspection reports of randomly selected 50 RMG factories have been analyzed with a Multi-Criteria Decision-making (MCDM) approach, the Criteria Importance Through Inter-Criteria Correlation (CRITIC) method, to determine the objective weights of the selected criteria. The number of risk factors observed in each criterion during fire safety inspections at the RMG factories has been considered as the numerical input for the CRITIC method. Prioritization has been obtained with the descending order of the computed weights for the risk criteria. This study finds that 'egress obstruction', 'causative factors', and 'fire separation' are the most three weighted risk criteria by applying the CRITIC method. This prioritization will be helpful for decision-makers when the hierarchical implementation of mitigation actions is necessary due to various managerial constraints. The result of this study is expected to aid the managers of RMG factories to be more specific and accurate in case of deciding in a challenging situation.

Keywords
Ready-Made Garment, Fire Risk Criteria, Multi-Criteria Decision Making, and Criteria Importance Through Inter-Criteria Correlation.

1. Introduction
Bangladesh is one of the largest RMG manufacturing nations in the world exporting products to more than 150 countries (BGMEA 2021), (Debnath et al. 2023). There are around 4500 factories, and over 4 million people are working in the RMG sector (Siraj et al. 2022a), (Fathi 2021). Ensuring a safe and sustainable workplace for such a huge industrial workforce is always a challenging issue for policymakers. In the last few decades, industrial fire-related hazardous incidents in RMG factories are the deadliest barrier to overcome by the managers of this sector (Siraj et al. 2022b), (Hasan et al 2017). The fire in Tazreen Fashion in 2012, which caused more than 100 deaths and

300 injuries, bring attention to the national and international community to find a sustainable solution against fire hazards (Wiersma 2018). In such a reality, the 'Accord' (Accord on Fire and building safety in Bangladesh) was formed in 2013 as a safety monitoring organization for more than 1700 RMG factories and the fire safety scenario started to improve gradually (Accord 2021). But there are a lot of scopes to improve yet in the remaining factories which are not under continuous monitoring by any regulatory authority. Fire safety inspections conducted with proper standardized structure at RMG factories can minimize the damage due to fire hazards (Wiersma 2018), (Siraj et al. 2022b). In this regard, analyzing the findings from the conducted fire safety inspections by the Accord can be insightful for the overall industry.

There are several studies on fire hazard issues in the RMG sector in recent literature. For instance, multiple works have been conducted to depict fire propagation characteristics, non-standard practices at factories, egress layout planning, evacuation scenarios, and so on (Khan et al. 2021), (Nilufar and Choiti 2019), (Khandoker et al. 2018). Among those, Khan et al. (2021) determined the negative effects of unsafe practices like egress obstruction, narrow escape, disturbance at fire doors, etc. on the safe evacuation of the occupants during a fire incident; Nilufar and Choiti (2019) tried to show a correlation between the spatial layout of the egress path and occupant's movement behavior in time of the fire; Khandoker et al. (2018) depicted the fire propagation pattern in a multistoried RMG factory building and its impact on the evacuation. Those works were conducted with computer-based simulation with numerical input for different risk factors as variables. They suggested mitigating unsafe practices and creating a safe evacuation environment during fire incidents. However, they did not attempt to prioritize the fire risk criteria to be mitigated one after another based on their priority.

Risky RMG factories have been sorted out by fire risk indexing (FRI) in some papers (Islam and Roman 2019), (Wadud and Huda 2017). For example, Islam and Roman (2019) as well as Wadud and Huda (2017) both divided the fire risk factors into two parameters- hard and soft. Hard parameters are for structural risk factors and soft parameters are for managerial risk factors. They tried to sort out the most vulnerable RMG factories based on the calculated FRI considering the hard and soft parameters of those factories. Barua et al. (2018) showed a comparison between the existing and the standard fire evacuation practices in the RMG factories in a descriptive manner. Haque et al. (2017) utilized the empirical statistical method to predict the number of burn incidents due to fire hazards from electrical faults. They took some electrical risk factors which are related to fire incidents as the computation variables. Some other recent works also focused on fire safety in the RMG sector. Those works discussed various aspects of fire risk factors, inspection regulation for fire safety, historical data on fire incidents, cause-effect analysis, and comparative analysis (Hasan et al. 2017), (Wiersma 2018), (James et al. 2019), (Moazzem et al. 2018), etc. However, no study has prioritized the fire risk criteria of the RMG sector to aid the industrial managers which can be identified as a research gap to be explored.

Besides those studies on the RMG sector, some other recent studies on urban and industrial fire risk factors can be mentioned here. For instance, Alkış et al. (2021) determined a ranking of the surrounding structures based on their vulnerability during an industrial fire. For this, they utilized an MCDM technique, the Analytical Hierarchy Process (AHP). Dârmon (2020) calculated the probability of various risky incidents related to fire hazards and predicted the consequences for industrial buildings. Omidvari et al. (2020) determined the riskiest zone of a hospital during a fire incident. For this, they applied a combination of the failure mode effect analysis (FMEA) and MCDM techniques. Yilmaz et al. (2020) analyzed the fire risk domains of the industrial area by applying an MCDM technique, the Fuzzy AHP. However, prioritizing the fire risk criteria by applying any of the objective criteria weighting methods for any industrial sector was not intended by the existing works in the literature. Therefore, this work is going to determine the prioritization of the fire risk criteria by applying an MCDM technique, the CRITIC method.

The CRITIC method is a popular MCDM method to find the objective weights of the criteria in such an environment where decision-makers are not confident to evaluate the criteria with their subjective judgment and there is a sufficient amount of numerical data of the alternatives for weighting the criteria (Diakoulaki et al. 1995), (Wu et al. 2020). The CRITIC method deals with both the standard deviation within a data set and the correlation among the data sets for determining the objective weights of the criteria which makes it more accurate and consistent than other objective weighting methods (Shi et al. 2020), (Pan et al. 2021), (Vujičić et al. 2017). There are several works in recent literature applying the CRITIC method to determine the objective criteria weights. For instance, by utilizing the CRITIC method, Wu et al. (2020) evaluated the operational safety of urban rail transit, and Shi et al. (2020) determined the weights for various power quality indicators by analyzing data from the power generation side and user side, Pan et al. (2021) proposed a framework for the evaluation of a heavy traffic problem, and so on. However, fire risk criteria weighting based on the observation in fire safety inspections has not utilized the CRITIC method yet. This shows the novelty of this ongoing work.

In this study, fire safety inspection reports from randomly selected 50 RMG factories have been gathered from the website Accord at first (https://bangladeshaccord.org/factories). Then, the observed risk factors from the selected reports have been categorized into 6 different criteria with the help of existing literature and the fire safety inspection reports. Later, the number of risk factors in each criterion for the 50 sample factories have been sorted out to be utilized as the numerical input for the CRITIC method. Finally, the CRITIC method has been applied to determine the criteria weights that have been used to present the prioritization.

1.1 Objectives

This study aims to fulfill the following objectives:

a) To categorize the fire risk factors into 6 criteria.
b) To sort out the number of risk factors observed in each of the criteria.
c) To determine the criteria weights by the CRITIC method.
d) To prioritize the fire risk criteria by the obtained weights.

The rest of the paper is arranged as Section 2 is for describing the methodology of the study, Section 3 is for depicting the data collection and calculations procedure, Section 4 is for discussing the obtained results, and Section 5 is for highlights the implications of the study, whereas, Section 6 is for concluding the paper by discussing the managerial implications of the result and the future study scope briefly.

2. Methods

The designed methodology for this study can be presented with the below explained 5 steps:

Step 1. Accumulate fire safety inspection reports of randomly selected 50 RMG factories from the website of Accord (https://bangladeshaccord.org/factories).

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Step 2. Identify the fire risk criteria to categorize the fire risk factors.

Step 3. Determine the number of risk factors observed in each of the criteria by analyzing the fire safety inspection reports of the randomly selected 50 RMG factories.

Step 4. Apply the CRITIC method to obtain the objective criteria weights by utilizing the number of risk factors in each of the criteria for numerical computation.

Step 5. Prioritize the fire risk criteria based on their obtained weights.

Details of the selected fire risk criteria to be prioritized in this study are shown in Table 1.

Table 1. Selected fire risk criteria to categorize the fire risk factors for the RMG industry in Bangladesh

Risk Criteria	Description	Source
Causative Factors (CF)	Risk factors that can be indicated as the cause of the fire are categorized in this criterion. For example, non-standard electrical cable connections; unterminated live wire; congested cables and bus bars in the electrical distribution board; the presence of a boiler and other heat sources on the production floor, etc.	Alkış et al. (2021), Dârmon (2020), Wang et al. (2021), Siraj et al. (2023)
Fire Separation (FS)	Risk factors related to the absence of fire-rated construction are categorized in this criterion. For example, no separation between boiler, generator, and transformer; openly stored combustible materials; Unsealed penetrations in the walls and ceiling; unseparated exit stairs with fire-rated walls; non-standard fire doors, etc.	Siraj et al. (2022b), Wang et al. (2021), Siraj et al. (2023)

Egress Obstruction (EO)	Risk factors related to the obstruction of smooth egress are categorized in this criterion. For example, material storage in the egress paths; narrow or lengthy emergency egress paths; non-standard locking features in the egress doors; inadequate egress doors, etc.	Khan et al. (2021), Nilufar, F., and Choiti (2019), Wang et al. (2021)
Fire Detection (FD)	Risk factors related to the absence or non-standard feature of the fire/smoke detection system are categorized in this criterion. For example, the absence of an audible fire alarm; the absence of a fire detector in each corner of the floor; irregular inspection, testing, and maintenance (ITM) of the fire detector, etc.	Dârmon (2020), Omidvari et al. (2020), Yilmaz et al. (2020)
Fire Protection (FP)	Risk factors related to the absence of non-standard features of the fire protection system are categorized in this criterion. For example, the absence of a sprinkler or standpipe; the capacity of a fire pump is less than the necessity; irregular ITM for the fire protection system, etc.	Moazzem et al. (2018), Yilmaz et al. (2020), Siraj et al. (2022b)
Egress Lighting (EL)	Risk factors related to the absence or non-standard feature of the lighting system in egress paths are categorized in this criterion. For example, inadequate lighting in the egress paths; absence of emergency lighting; absence of illuminated exit signs, etc.	Khan et al. (2021), Khandoker et al. (2018)

3. Data Collection and Calculations

After analyzing fire safety inspection reports generated by the Accord for 50 RMG factories (denoted as F1, F2, F3, …, F50), the number of risk factors in each of the criteria has been noted for further calculation. This can be found in the primary decision matrix shown in Table 2. Those reports have been published by the Accord after completing factory inspections by trained fire safety engineers (Siraj et al. 2022a), (Accord 2021).

Table 2. Number of risk factors in each risk criterion for randomly selected 50 RMG factories

	CF	FS	EO	FD	FP	EL
F1	1	1	4	2	2	2
F2	2	3	6	3	5	2
F3	5	4	10	4	5	4
F4	4	2	6	3	4	4
F5	1	1	2	3	1	1
F6	2	1	3	2	1	2
F7	7	4	13	10	6	8
F8	2	1	5	3	2	4
F9	2	1	4	2	2	3
F10	3	1	4	1	1	2
F11	2	2	7	2	3	3
F12	3	2	6	2	3	2
F13	9	6	8	6	8	8
F14	2	2	9	4	3	4
F15	1	0	4	4	1	5
F16	4	3	7	5	4	5
F17	3	1	4	2	2	3
F18	3	2	3	2	2	2
F19	4	1	4	4	2	2
F20	9	5	10	7	5	8
F21	4	2	7	4	2	2
F22	3	1	7	3	3	2
F23	3	1	11	3	2	4
F24	4	2	7	4	2	2
F25	3	4	6	2	5	4

	CF	FS	EO	FD	FP	EL
F26	0	1	5	1	0	2
F27	1	1	2	1	3	1
F28	0	2	3	1	1	2
F29	1	3	8	3	2	3
F30	1	5	4	2	5	2
F31	0	3	2	2	4	4
F32	2	1	3	1	2	2
F33	6	2	10	3	4	3
F34	1	2	0	2	2	4
F35	2	2	3	1	2	0
F36	1	2	2	3	3	5
F37	6	4	4	2	5	4
F38	0	1	1	3	1	4
F39	4	1	4	1	2	3
F40	3	3	5	3	3	4
F41	2	3	6	4	4	6
F42	3	3	3	4	3	4
F43	4	4	14	4	5	5
F44	1	1	2	3	0	3
F45	1	2	9	4	1	5
F46	4	1	2	3	2	4
F47	7	5	8	7	7	10
F48	7	1	9	4	2	6
F49	4	2	3	2	3	3
F50	1	1	4	2	1	3

Some pictures of the critical fire risk factors from the Accord inspection of the RMG factories of Bangladesh can be found in Figures 1 and 2.

Figure 1. Areas used for combustible storage are not separated by fire-rated construction (Accord 2021)

Figure 2. Unsealed (electrical riser) shafts located in the fire-rated floor/ceiling assemblies are not separated by fire-rated construction (left), Obstructed egress due to the storage of goods (right) (Accord 2021)

3.1 CRITIC Method

The CRITIC method has been widely used in various fields, including business, engineering, and decision-making. One of the advantages of this method is its ability to handle both numerical data and practical observations, such as simulation values, test results, statistics, and various measurement parameters. This flexibility allows decision-makers to incorporate a wide range of inputs into their decision-making process (Diakoulaki et al. 1995).

In this particular study, the researchers have chosen to use the number of fire safety inspection findings or fire risk factors in each of the risk categorizing criteria as a numerical input to calculate the weights of the risk criteria. This approach provides a quantitative basis for the decision-making process, which can help to ensure that decisions are based on objective data rather than subjective opinions or biases. By utilizing the CRITIC method, the researchers can assign appropriate weights to each of the risk criteria based on their relative importance in the decision-making process. This, in turn, can help to prioritize actions and allocate resources more effectively, ultimately leading to better outcomes.

The details method (Diakoulaki et al. 1995), (Pan et al. 2021) can be found below:

Step 1. Generate the initial decision matrix for 50 RMG factories (See Table 2). The mathematical expression for the initial decision matrix is as Equation (1)

$$D = \begin{array}{c} \\ F1 \\ F2 \\ \dots \\ \dots \\ Fm \end{array} \begin{array}{c} \begin{array}{cccc} C1 & C2 & \dots & Cn \end{array} \\ \begin{bmatrix} d_{11} & d_{12} & \dots & d_{1n} \\ d_{21} & d_{22} & \dots & d_{2n} \\ \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots \\ d_{m1} & d_{m2} & \dots & d_{mn} \end{bmatrix} \end{array} \quad (1)$$

Step 2. Normalize the initial decision matrix by using Equation (2)

$$r_{ij} = \frac{d_{ij} - \min d_j}{\max d_j - \min d_j} \quad (2)$$

Step 3. Calculate the standard deviation for each of the risk criteria by using Equations (3) and (4)

$$\overline{r_{ij}} = \frac{1}{m} \sum_{i=1}^{m} r_{ij} \quad (3)$$

$$S_j = \sqrt{\frac{\sum_{i=1}^{m} (r_{ij} - \overline{r_{ij}})^2}{m-1}} \quad (4)$$

Here, m= Number of Alternatives (In this study, 50 factories have been considered, so, m= 50); S_j= Standard Deviation

Step 4. Compute the linear correlation coefficient ($r_{j,j'}$) for each pair of criteria separately to form a symmetric matrix.

Step 5. Compute the conflicting character of the criteria by using Equation (5)

$$R_j = \sum_{j'=1}^{n} (1 - r_{j,j'}) \quad (5)$$

Here, R_j is the correlation index of the j^{th} criterion and $r_{j,j'}$ is the linear correlation coefficient for j^{th} and j'^{th} criteria. The higher the value of R_j, the lower the conflict of that criterion with other criteria.

Step 6. Calculate the amount of information in each criterion by using Equation (6)

$$C_j = S_j \times R_j \quad (6)$$

Here, S_j and R_j are obtained by using Equations (4) and (5) respectively.

Step 7. Calculate the weights of the criteria by using Equation (7)

$$W_j = \frac{C_j}{\sum_{j=1}^{n} C_j} \quad (7)$$

Step 8. Once the weights of the risk criteria have been computed using the CRITIC method, the next step is to prioritize the criteria based on their relative importance. This can be achieved by arranging the criteria in descending order of their weights, with the most important criteria appearing at the top of the list.

3.2 Calculations

The calculated normalized matrix from the initial decision matrix can be found in Table 3. Standard deviation values (S_j) for the criteria have also been calculated.

Table 3. Normalized Decision-Matrix

	CF	FS	EO	FD	FP	EL
F1	0.111	0.167	0.286	0.111	0.250	0.200
F2	0.222	0.500	0.429	0.222	0.625	0.200
F3	0.556	0.667	0.714	0.333	0.625	0.400
F4	0.444	0.333	0.429	0.222	0.500	0.400
F5	0.111	0.167	0.143	0.222	0.125	0.100
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F46	0.444	0.167	0.143	0.222	0.250	0.400
F47	0.778	0.833	0.571	0.667	0.875	1.000
F48	0.778	0.167	0.643	0.333	0.250	0.600
F49	0.444	0.333	0.214	0.111	0.375	0.300
F50	0.111	0.167	0.286	0.111	0.125	0.300
S_j	0.246	0.228	0.223	0.192	0.217	0.196

A symmetric matrix is formed with the linear correlation coefficient values which can be found in Table 4. Calculated R_j, C_j, and W_j Table 4 can be found in Table 5. The final prioritization of the criteria is also presented in Table 5 and Figure 3.

Table 4. Symmetric matrix with linear correlation coefficient values

	CF	FS	EO	FD	FP	EL
CF	1	0.536	0.572	0.640	0.651	0.604
FS	0.536	1	0.439	0.522	0.871	0.569
EO	0.572	0.439	1	0.621	0.486	0.484
FD	0.640	0.522	0.621	1	0.552	0.790
FP	0.651	0.871	0.486	0.552	1	0.605
EL	0.604	0.569	0.484	0.790	0.605	1

Table 5. R_j, C_j, W_j and prioritization of the criteria

	CF	FS	EO	FD	FP	EL	R_j	C_j	W_j	Rank
CF	0	0.464	0.428	0.360	0.349	0.396	1.997	0.491	0.186	**2**
FS	0.464	0	0.561	0.478	0.129	0.431	2.063	0.470	0.178	**3**
EO	0.428	0.561	0	0.379	0.514	0.516	2.397	0.535	0.203	**1**
FD	0.360	0.478	0.379	0	0.448	0.210	1.875	0.361	0.137	**6**
FP	0.349	0.129	0.514	0.448	0	0.395	1.836	0.399	0.151	**4**
EL	0.396	0.431	0.516	0.210	0.395	0	1.949	0.382	0.145	**5**

4. Results and Discussion

This study finds the weights of the fire risk criteria by the CRITIC method as (see Table 5 and Figure 3) Egress Obstruction (0.203)> Causative Factors (0.186)> Fire Separation (0.178)> Fire Protection (0.151)> Egress Lighting (0.145)> Fire Detection (0.137). The CRITIC method is a measurement considering both the deviation of the objective values for a criterion and the correlation of the objective values among the criteria. Therefore, the obtained weights from this study show, during fire safety inspections at the RMG factories, 'egress obstruction' related risk factors are the most prior observation from the inspectors, and the number of the risk factors for the factories in this risk criterion is comparatively more consistent than other risk criteria. On the other hand, the number of risk factors related to 'fire detection' for the selected factories is comparatively more dispersive in the pattern. Therefore, the weight for this criterion is the minimum.

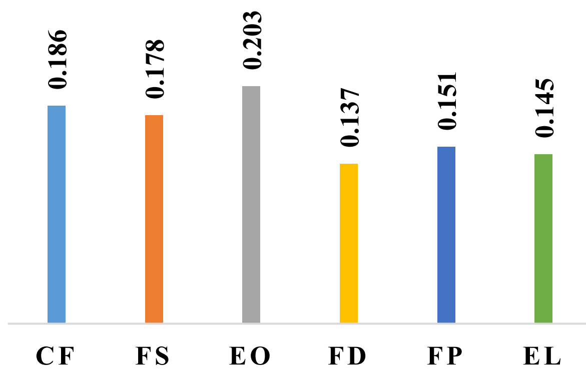

Figure 3. Weights of the fire risk criteria for Prioritization

Earlier studies show that egress obstruction is the main challenge for safe evacuation in the RMG factories (Khan et al. 2021), (Nilufar and Choiti 2019). This criterion is directly related to life savings during a fire. Most of the RMG factories are designed with a very congested layout due to various constraints as well as managerial negligence. Thereby messy arrangements of the production floor, material storage, and machinery obstruct the egress paths which can be deadly during a fire evacuation. Moreover, unfeatured egress doors, locked doors, and the inadequacy of doors in comparison to the occupant load are some of the most frequently seen egress obstructions in RMG factories. The obtained result from this study prioritizes the egress obstruction-related risk factors most. That means while thinking of fire risk mitigation strategies, managers need to focus on removing all types of obstructions from the egress paths at first.

After assuring unobstructed egress, 'causative factors' for fire come next in the obtained result as the prioritized risk criteria. Fire from electrical faults like short circuits or sparks has been identified as the most observed causative factor behind the major fire incidents in RMG factories (Haque et al. 2017). Besides this, unprotected heat-producing instruments like boilers, generators, and transformers were also the reason for fire hazards (Siraj et al. 2022b), (Bari et al. 2022). Fire incidents can be minimized by mitigating the causative factors following proper standards, thereby the result of this study, obtained from the fire safety inspection report analysis, emphasizes this criterion comparatively higher than the remaining criteria.

Fire separation helps to obstruct the propagation of fire which is the third prioritized risk criterion achieved in this study. Managers of the RMG factories often neglect the fundamental requirements of fire separation because of their lack of awareness. The source of fire or the already affected area must be separated from the unaffected places to obstruct fire propagation (Khandoker et al. 2018). Fire separation can be assured by various fire-rated construction like the fire-rated wall, fire doors, sealed penetration, etc.

After the top prioritized three fire risk criteria, mitigating the remaining three criteria- fire protection, egress lighting, and fire detection is part of maintaining the sustainability of the established fire safety practices in an RMG factory. The analyzed fire risk criteria in this study were also discussed and emphasized in many of the previous research works, which justifies the relevance of this work. So, managers may decide on the fire risk mitigation action plan focusing on the prioritized position of the risk criteria.

5. Managerial Implications of the Study for Operational Sustainability

The findings of this study have several significant managerial implications for the operational sustainability of the RMG industry in Bangladesh. The prioritization order of the fire risk factors identified in this study can assist decision-makers in implementing mitigation strategies and improving the overall safety and sustainability of the industry. One of the key implications of this study is that decision-makers can use the prioritization order of the fire risk factors to allocate resources like human resources and machines more effectively (Islam et al. 2022). By focusing on the most important risk factors first, decision-makers can ensure that they are addressing the most significant risks and opportunities, which can lead to better outcomes and more efficient use of resources. This can help to prevent fire incidents and promote sustainable operations in the RMG industry.

Another important implication of this study is that it can aid managers of RMG factories in decision-making when faced with challenging situations. By having a clear prioritization order of the fire risk factors, managers can be more specific and accurate in their decision-making and take necessary actions to mitigate risks. This can ultimately lead to improved safety, sustainability, and operational efficiency of the RMG factories. In addition, this study highlights the importance of regular fire safety inspections in RMG factories. By analyzing the fire safety inspection reports, decision-makers can identify the most critical risk factors and take appropriate actions to mitigate them. This can help to prevent fire incidents and improve the overall safety and sustainability of the RMG industry.

While this study focused primarily on fire safety and operational sustainability in the RMG industry in Bangladesh, it can also contribute to achieving environmental sustainability in the long term. The prioritization order of fire risk factors identified in this study can help decision-makers in the RMG industry to identify areas where they can implement sustainability measures that have environmental benefits. For instance, if the study identifies the "causative factors" criterion as a high-risk factor, then decision-makers can focus on reducing factors that contribute to fire incidents such as improper waste management and poor handling of flammable materials (Chowdhury et al. 2023). By addressing these factors, decision-makers can also reduce the environmental impact of the RMG industry. Moreover, the implementation of mitigation strategies to address high-risk factors in the prioritization order of fire risk factors identified in this study can also have a positive impact on the environment. For example, improving fire protection measures and egress lighting can reduce the risk of fire incidents and prevent environmental damage caused by toxic smoke and hazardous chemicals released during a fire.

As decision-makers prioritize fire risk factors and allocate resources to address them, they may identify opportunities to implement sustainable practices, such as using renewable energy sources. For example, decision-makers may choose to invest in renewable energy sources such as solar panels or wind turbines, as a way of reducing their reliance on non-renewable energy sources and mitigating environmental risks (Payel et al. 2023), (Siraj et al. 2022c). Additionally, decision-makers may recognize that investing in renewable energy sources can not only help mitigate environmental risks but can also contribute to operational sustainability by reducing energy costs and improving the efficiency of RMG factories.

6. Conclusion

A novel approach to applying the CRITIC method has been depicted in this study. Generally, fire safety inspections are conducted in RMG factories by trained fire safety engineers of the Accord. Though their findings of the risk factors are structured, several human factors can affect the inspection reports. This study has considered fire safety inspection reports from 50 randomly selected RMG factories. The number of risk factors in each criterion for the selected factories has been taken as numerical input of the CRITIC method. Therefore, objective weights of the risk criteria obtained in this study are influenced by the subjective judgment of the fire safety inspectors.

In a developing country like Bangladesh, limited resources and managerial constraints always dominate the decision-making procedure of the industries. Mitigating all the risk factors at a time seems very impractical in this situation. The interesting finding from this study is to achieve a pattern for fire risk mitigation. First, make a safe evacuation environment; then, ensure the removal of fire-causative factors; next, install a fire separation structure; finally, ensure the sustainability of the established fire safety culture. The obtained result from this study can aid managers to find a hierarchical mitigation strategy.

The size of a dataset is influential on the result obtained in the CRITIC method. In the future, various statistical sampling methods can be utilized to obtain an optimum dataset size and the fire safety inspection reports from more factories can be analyzed to compare the consistency of the result. Further, experts' opinion-based MCDM techniques can be applied to get an extensive overview of this study. Determining the influence of one risk criterion over another can also be considered an upcoming study scope.

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