Research on Risk Evaluation of Large-scale Shopping Mall Based on Improved AHP Derived From EWM and TOPSIS

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Abstract: Because of its complex environment and intensive personnel, large shopping malls are very passive in their consequences and impact in the event of an accident. Therefore, in the aftermath of major shopping mall accidents, the government, large shopping malls, and victims all bear great economic pressure. Therefore, the purpose of this paper is to determine an effective safety evaluation system. Starting from the existing risks, the first 8 experts use the Analytic Hierarchy Process (AHP) to conduct safety evaluation analysis on general large-scale shopping malls, then apply TOPSIS analysis method and entropy weight method based on the results, and obtain the best expert judgment.

1. Introduction

In the previous risk analysis and safety evaluation of shopping malls, there are many methods used in AHP analysis. However, due to constraints imposed by experts' individual judgments, they may be inconsistent with the actual conditions of the shopping malls, and the evaluation contents are not accurate enough. The significance of this paper lies in proposing a method to improve AHP based on entropy weight method and TOPSIS method. It first uses AHP to evaluate the safety of general shopping malls, and then uses TOPSIS analysis method and entropy weight method to integrate evaluation according to the results. The weight of the optimal expert judgement, the study of this article not only can be carried out for the safety evaluation of the entire large-scale shopping mall industry, but also provides a basis for supervision of the management department, but also can gradually promote the application of this evaluation system model to other industries and public places..

2. Risk Factors of Large-scale Shopping Malls

In general, the business system of large shopping malls is a dynamic system in space and time. Therefore, the risk factors in large shopping malls involve a wide range of complexities. From the perspective of systems theory such as security principles and system security, the factors affecting security can be attributed to people, machines, environment, and management. Therefore, it is very necessary to analyze the risks from the exterior, internal and security management of large-scale shopping malls.

2.1 External risk

The main categories are natural environment risks, surrounding environmental risks and construction risks. The construction risk is mainly the analysis of its construction structure, decoration materials, construction scale and construction of fire exits. The size of the building is directly related to the economic losses that may occur in the shopping mall. The larger the building size of the shopping mall, the more its assets, the greater the flow of people, the more complex the internal layout, and the greater the degree of difficulty in fighting fire fighting, which may occur. The casualties and property losses caused by the accident are correspondingly larger.

2.2 Internal risk

The main categories are fire risk, stampede risk, altitude drop risk, elevator risk, risk of door and window squeezing, and floor fall risk. For large shopping malls, preventing fire is a topic that will never be out of date.

2.3 Security management risk

Including safety management personnel risks, emergency plans and fire drills, safety education, firefighting facilities and equipment maintenance, safety monitoring centers, and safety management systems. Safety management is especially important for companies. It is about the production and development of companies..

3. Establishment of Risk Assessment System

3.1 Introduction to Evaluation Methods

The basic principle of the Analytic Hierarchy Process (AHP) is to decompose the problem into different compositional factors according to the nature of the problem and the overall goal to be achieved, and to aggregate the factors according to their interrelated influences and affiliation relationships according to different levels. A multi-level analysis of the structural model ultimately leads to the problem being determined at the lowest level (plans, measures for decision making, etc.) relative to the determination of the relative importance of the highest level (total goals) or relative priority ranking.

Entropy weight method is based on the accurate data of objective existence, the entropy algorithm is introduced into it, based on which the mathematical method for calculating the weight of each index is calculated. The entropy weight of each indicator reflects the amount of information mapped by the data in this indicator. Generally speaking, the greater the difference in data, the greater the amount of information reflected and the higher the relative weight.

The Topsis analysis method was first proposed by CLHwang and K. Yoon in 1981. The Topsis analysis method ranks a limited number of evaluation objects and the degree of closeness to idealized goals, and evaluates the relative merits of existing objects. The Topsis method is a sorting selection method that approximates the ideal solution.

For the same sample, the evaluation results should not be very different, but in the actual evaluation process, because the principle of a single evaluation method is different, so the evaluation of the same research object often results in different evaluation As a result, sometimes even opposite conclusions are obtained. Therefore, before the combined evaluation, it is necessary to conduct a preliminary inspection, that is, a consistency test. In this paper, the consistency results of the weighted results of the two methods are tested according to the Kendall co-coefficient test.

3.2 Establishment of safety evaluation index system for large-scale shopping malls

- Establishment of risk assessment system

According to the risk analysis conducted by the shopping malls above, the risk assessment system established is shown in Figure 1.

Target layer	Criteria layer	Plan layer
Shopping mall risk factors A	Environmental risk B1	Natural environment risk C1
		Environmental risk C2
	Construction risk B2	building structure C3
		Decoration Materials C4
		Construction scale C5
		Fire exits C6
	Fire risk B3	Electrical fire risk C7
		Maintenance fire risk C8
		Catering fire risk C9
		Artificial fire risk C10
		Commodity own risk C11
		Natural causes C12
		Fire facilities C13
	Stepping on risk B4	Emergency evacuation C14
		Safety exit lighting C15
		Emergencies C16
	Falling risk B5	Fence crash falling C17
		Suspension falls C18
	Elevator risk B6	Elevator falling C19
		machine malfunction C20
	Door and window extrusion risk B7	Daily evacuation C21
		Door and window failure C22
	Ground fall risk B8	Personnel negligence C23
		Weather natural causes C24
	Safety Management Risk B9	Security manager C25
		Emergency plan and fire drill C26
		safe education C27
		Facility maintenance C28
		Security Monitoring Center C29
		Safety Management System C30

Figure 1 Shopping mall risk assessment system table

In combination with the method described above, this paper invites eight experts to score points. The AHP judgment matrix and the weights determined according to the scores of experts are acceptable, and the weights of the criteria layer and the weights of the plan layers can be obtained.

- Entropy Weight Determination of Weights

Taking the weight of the criterion level as an example, the weights are calculated using the entropy method, and the sum of the weight of each indicator of each expert and the weight obtained from the entropy method based on the weight value is taken as its comprehensive evaluation value. The criteria layer evaluation values are shown in Table 1.

Based on Table 1, the comprehensive evaluation value of the scheme layer can be obtained by the same reason, shown in Table 2.

Table 1 Criteria Evaluation Value about EWM

Expert1	0.07349
Expert2	0.07681
Expert3	0.07213
Expert4	0.07328
Expert5	0.07599
Expert6	0.07699
Expert7	0.07908
Expert8	0.07129

Table 2 Plan Evaluation Value about EWM

Expert1	0.02892
Expert2	0.03173
Expert3	0.02812
Expert4	0.02892
Expert5	0.03120
Expert6	0.02963
Expert7	0.02825
Expert8	0.02653

Therefore, according to the Table 2, the risk factor weights of the criterion level of the entropy weight shopping mall are selected by the expert 7 and the factor weight of the program level is selected by the expert 2.

- TOPSIS Analysis Method to Determine Weights

Taking the criterion level weights as an example, the TOPSIS analysis method is used to calculate the weights. According to TOPSIS's evaluation value formula, the TOPSIS evaluation values are calculated and ranked. The results are shown in Table 3.

Table 3 Criteria Evaluation Value about TOPSIS

Expert1	0.333998448
Expert2	0.409475623
Expert3	0.262899995
Expert4	0.321984649
Expert5	0.387956795
Expert6	0.427209025
Expert7	0.567606467
Expert8	0.298061081

Table 4 Plan Evaluation Value about TOPSIS

Expert1	0.411238611
Expert2	0.618493003
Expert3	0.311236231
Expert4	0.351448505
Expert5	0.635859151
Expert6	0.372398004
Expert7	0.328018072
Expert8	0.177348062

Based on the above, the comprehensive evaluation value of the scheme layer can be obtained with the same reason, as shown in Table 4.

Therefore, according to Table 4, the experts at the criterion level 7 and the experts at the program level 5 have the highest scores. Therefore, the risk factor weight of the TOPSIS large shopping mall criterion level is selected by the expert 7 and the factor weight of the program level is selected by the expert 5.

3.3 Integrated comprehensive evaluation

- Combination Evaluation Consistency Test

Through the above two analysis methods, the ranking of experts on the criteria level and the program level will be obtained, and then the consistency check will be conducted according to the ranking of experts. Taking the ranking of experts at the standard level as an example, the entropy method and the Topsis analysis method are checked for consistency. It is significant to calculate this co-coefficient, that is, the two methods have consistency at the criterion level. Based on the above, similarly, the computational plan layer also has consistency.

- Integrated Comprehensive Evaluation Method to Determine Weights

According to the results of the Analytic Hierarchy Process, the results of the TOPSIS analysis method and the entropy-weighted method are used to reflect the characteristics of the data from different aspects and have equal importance. Therefore, if the weights of the two methods are each 0.5, the two The final weight of the integrated evaluation results of the methods can be obtained.

4. Conclusion

This paper analyzes the risk factors of large-scale shopping malls. Through the scoring results of eight experts, the TOPSIS analysis method and entropy weight method are used to determine the weight of the optimal expert judgement, and an integrated safety evaluation index system for large-scale shopping malls is established. The objective weighting method using TOPSIS analysis and entropy weight method effectively avoids the subjectivity of subjective weighting methods such as AHP, and the integrated evaluation method of both methods is more scientific and rational.

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