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Procedia Engineering 45 (2012) 240 – 247

Procedia Engineering

www.elsevier.com/locate/procedia

2012 International Symposium on Safety Science and Technology

Public places safety management evaluation of railway stations

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Abstract

With more and more attentions paid to safety problems in public places by the whole society, preventions and controls of unexpected events in the crowded places of railway stations are especially important. Aimed at the safety problems in railway station, such as crowded people, complex environment, weak management and so on, in order to make the public places safety management of railway stations more effective, through analysis of public places system safety features and hidden dangers of railway stations, public places safety management evaluation indicators system is constructed and aimed at every specific indicator. Corresponding safety management and control requirements are put forward. Taking Xi'an Railway Station as the example, Analytic Hierarchy Process (AHP) is used to get indicators weight values. Public places safety main control factor is obtained by analysis. According to the evaluation results, aimed at the weak links in safety management, improvement measures are put forward, supplying an important basis of perfect safety management system and improvement of safety management.

Keywords: railway station; public safety; safty management; evaluation

Nomenclature

c	complexity
m	actual relationships number of factors in the system
n	the smallest possible relationships number

1. Introduction

With the development of Chinese urbanization level, more and more attentions are paid to safety problems of public places[1]. Public place is an important window formed by city construction, social development and spiritual civilization. Its public safety reflects "people-oriented" undertaking fully. It is the important guarantees of national economy and people's livelihood, and the basis of country development. Every area all over the country, beginning with construction of harmonious society and realization of sustainable development of public safety, is combined with the Chinese actual situations, practice scientific development and perfect city functions. Among them, security management and early warning of large crowded public places like railway stations are main problems in the development of city public safety. Therefore, studies on guarantee of personnel and property safety in such public places, analyses of influence factors and interrelations of its safety status and constructions of safety evaluation system applying to scenes prove the basis for security management and early warning of large public places, and supply an important guiding role in construction of scientific management system and long-term management mechanism for related government departments.

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doi:10.1016/j.proeng.2012.08.151

2. Analyses of public places system safety features of railway stations

Public places are crowded places, where people are engaged in daily public activities. They are indispensable parts in our life[2]. As a place conveying a large number of passengers everyday, a railway station is a perpetual motion of large system. In the view of system, public places safety features of railway stations are analyzed as complexity, brittleness, uncertainty and open[3].

2.1. Complexity

Daily activities in squares in front of railway stations include merchant activities, temporary engineering, passengers' complaints, traffics, city health and greening, taxies management, advertisements, flow management and so on. There are many complex factors in the entire system; the problems, such as unlicensed mobile individual traders and blunt managers, are solved complexly; besides, many unexpected events need to be solved by a lot of departments, which results complex work. Judgment equation of system complexity is following[4].

$$c = \frac{m}{n-1} \tag{1}$$

$$\text{complexity} = \frac{\text{actual relationships number of factors in the system}}{\text{smallest possible relationships number}} \tag{2}$$

where c is complexity, m is the actual relationships number of factors in the system, and n is the smallest possible relationships number.

In such system, which is formed by "people, facility, environment, management" four factors, there is:

$$c = \frac{m}{n-1} = \frac{2^4}{4\text{-}1} = \frac{16}{3} > 1 \tag{3}$$

So in such complex system formed by "people, facility, environment, management", like the square in front of a railway station and its surrounding area, its complexity embodies that the four factors' relationships are not limited in two factors', but three or four factors are interrelated.

2.2. Brittleness

Public places like a railway station is a complex system. When one subsystem or one part breaks down because of internal or external disturbances or attacks, other subsystems or parts will also break down, resulting to entire system break down. What is above is system brittleness[5], which is a basic characteristic under complex environment. Brittleness runs through every link of the whole system, and cannot disappear with the change of entire environment or influence of external conditions.

2.3. Uncertainty

In public places, where people come to take move for the purpose, there are large flowability and large number of people not knowing each others and having no action target. Therefore, one of its obvious features is traffic developed and people and traffic's flowabilities are large, which results to uncertainty of public places enlarged. Frequent unexpected events can occur resulted from such uncertainty.

2.4. Open

Public places carry people's daily activities and social life. The play of their roles is in close contact with surrounding environment. They can interact with environment and develop towards better adapt to the environment. For all of external excitations, their first responses are passive acceptance and not active denial. Because of open system, in some particular period, some unexpected events like accidents and stampedes can appear.

3. Analyses of public places safety influence factors of railway stations

In the view of public safety analysis, there is obvious complexity in the square in front of a railway station, including each link of basic daily necessities of life and each possibility of social contradictions' coincidence. There are many influence factors of square public safety. Based on the management science's discussion of statuses of "people, facility, environment, management" four aspects, public safety situation in the square in front of a railway station can be analyzed entirely from people factor, facility factor, environment factor and management factor[6].

3.1. Analysis of people factor

As crowded public places, railway stations become the places where many kinds of people gather around. People in the square in front of a railway station can be divided into passengers, managers, traders and other related people four classes.

①Passengers and managers are directly related to main functions of railway stations, in which the largest proportions of the total number are occupied by passengers and their relatives and friends. Managers include public service suppliers and public order sustainers.

②Traders engage in commercial activities because of business opportunities, so merchant activities not only service passengers but also profit the traders. Therefore, a lot of "edge-ball" style illegal businesses appear.

③Range of other related people is large, which includes homeless, beggars, social idlers, opportunistic theft or robbery criminals, purposeful potential criminals, terrorists eager for the fray and every stratum having collective demands. These related people above include different groups having different political positions and legal consciousnesses. However, the persons who have hostilities to our society and intentional criminal intents can not be recognized or solved directly in the daily management before their implementations of illegal actions, so in the public safety management of square in front of a railway station, all people are controlled and illegal activities are handled according to laws. Besides, major public safety cases or terrorist attacks are replied by perfect emergency plans. Thus, in the square public safety management, the "other related people" are classified into same macroeconomic analysis because of their overt behaviors or potential motives.

Because of high mobility and incompact organizations of passengers, they are obviously vulnerable in front of possible injuries. Traders engage in commercial activities for a long time in the square, familiar with the situations and fully understand policies and regulations, so they supply indispensable commercial services. But a lot of problems of interference with the normal orders even illegal trades arise. Therefore, clear, reasonable and firm management is needed to solve these problems above. Generally speaking, the square public safety and its effective operation can be affected and interrupted more or less by the "other related people" in the section, who include law-abiding citizens, irresponsible exclusions, law-breaking criminals and criminal trend subversives.

3.2. Analysis of facility factor

Facilities in the square in front of a railway station include:

①Infrastructures: including power supply, communication, water supply, drainage, road, emergency access system, parking and so on.

②Daily Management Facilities or Systems: including video monitoring, broadcast, emergency communication, extreme weather response and so on.

③Passengers Service Facilities or Systems: including diet, rest, burst injury treatment, health, complaint, information and so on.

④Sudden Danger Treatment Facilities or Systems: flood control facilities, fire fighting facilities, smoke detection and sprinkling systems, emergency shelters and so on.

Built couples of years ago, these systems have been improved many times. But some problems resulted from repairs are unavoidable. Especially, with the dramatically increasing throughput because of the fast development of economics, the situation of related facilities overload operation becomes very serious. Once the facilities in the square break down, consequence affecting public safety may be triggered directly. For example, if fire fighting systems cannot be used in a conflagration, serious result will appear. Instead, more indirect public safety influences are resulted from facilities failures. For example, lighting system's failure can lead to a greater hidden danger of criminal offense. As a result, facility factor also occupies an important position in public safety management of the square in front of a railway station.

3.3. Analysis of environment factor

Environment factor of railway stations is divided into natural environment and social environment two parts.

①Natural environment is the basis of social environment, and social environment is the development of natural environment. There may be spring tide, earthquake, snow damage and other natural disasters in natural environment, which can be controlled by people, and only can be solved by improving the synchronous control method.

②Social environment is led by mainstream social atmosphere, and its specific expressions are landscaping and health of square, control and artificial management of atmospheric pollution, prevention of a variety of outbreak and epidemic, man-made terrorist events and some public activities. Some unsafe parts in environment factor can affect directly the stability of people under the environment, which can lead to stress of overall environment. As a result, environment factor is also an important factor for public places safety.

3.4. Analysis of management factor

In the view of all management departments of railway stations, management factor affecting railway station safety can be divided into internal management factor and external management factor.

①Internal management factor includes management system executed by each function branch and safety management training of staff in management mechanism.

②External management factor is management work and management system of railway stations public places for management staff.

These two factors are interdependence and form an integral whole. Only when internal management factor plays a role, can external management factor be put directly forward to producing due effects. External management factor involves travelers' complaint management, food and restaurants' health management, trader management, every shop management, basic device management, bringing "three goods" (inflammable, explosive and dangerous goods) management and so on. All loops of railway stations routines are rule-based. Therefore, management factor is most critical in public places safety, and indispensable factor.

4. Evaluation on public places safety levels of railway stations based on AHP

Through analysis of public places system safety features and hidden dangers of railway stations, combined with the functions of every loop of public safety events' occurrence, development, reply, treatment and dealing with aftermath, public places safety levels evaluation can be summed up as infrastructures and environmental conditions, daily management and emergency management three factors.

(1) Infrastructures and environmental conditions are the factors closely related with railway stations normal operation. Therefore, the factor's assessments should be launched from system environments and hardware environments.

(2) Daily management is the visual expression of work effect of railway stations managers. Its branches should include supervision of commercial activities, supervision of service quality, supervision of entire security environment of area and team construction, so that the implementation degree of management can be assessed in the round.

(3) Emergency management is mainly aimed at whether unexpected events can be responded and assessed timely. Thus, whether plans of every kind of events and emergency resources are complete needs to be checked.

Through the above analyses, construction of public safety management evaluation indicators of railway stations is show in Table 1. Safety management and control requirements are put forward aimed at each specific indicator. In them, public places safety management of railway stations is expressed with A as first class indicator; environmental conditions, daily management and emergency management are respectively expressed with (B1, B2, B3) as second class indicators; the third class indicators belonging to second class indicators are expressed with (C1, C2, …, C36). Xi'an Railway Station is chosen to launch analysis of evaluation applications. Through site survey, experts live score each indicator. AHP is used to calculate the weights of each hierarchy. System of evaluation indicators and calculation results of weights of each hierarchy are shown in Table 1. Safety management evaluation classification is shown in Table 2.

Table 1. Safety management evaluation indicators of Xi'an Railway Station

Check Items	Live Score of Hierarchy C	Weight of B-C	Weight of A-B	Evaluation Values of Hierarchy B	Specific Requirements

Infrastructures and environmental conditions（B_1）	Early warning and warning information releasing system（C_1）	80	0.08145	0.3185	83.5	Early warning system in line with national industry standards; a 24-hour emergency telephone; warning information transmission and distribution channels
	Normal and emergency communication system（C_2）	85	0.09390			Reliable work, unimpeded signals, and a standby emergency communication system
	Traffic system in front of railway stations（C_3）	81.67	0.08845			Shunt orderly and set obvious traffic sign
	Parking conditions（C_4）	83.33	0.09390			Specific indication; lighting system, ventilation system and drainage system can work reliably
	Waiting and pick or farewell environment（C_5）	83.33	0.09390			Safe, reliable and security
	Basis of area environment（C_6）	81.67	0.08845			Daily equipments should be all in readiness and available
	Power supply system（C_7）	91.67	0.12894			Power supply should be stable, can stand lighting load and should be in line with national industry standards
	Water supply and drainage system（C_8）	80	0.08379			Set water supply and drainage system and make sure it is available
	Fire-control environment and facilities（C_9）	83.33	0.09390			All kinds of fire fighting measures should be all in readiness and fire exit should be unimpeded
	Flood control system（C_{10}）	88.33	0.09390			Complete flood control equipment
	Escape route in underground space and its capacity（C_{11}）	71.67	0.05941			Make sure its evacuation capacity
Daily	Construction of the professional team of safety management（C_{12}）	81	0.06162			Administrators should be trained for work according to request. Effective management system should be made
	Management system and its implementation（C_{13}）	89.33	0.07099			Improve management system constantly and supervise implementation process
	Area public security management（C_{14}）	90.67	0.07428			Security and no group events

management (B_2)	Flow guidance and management of area (C_{15})	85	0.06162			Set traffic guide signs and make shunt planning
	Management of communication platform of public information (C_{16})	85	0.06162	0.4735	84.4	Make sure timely information dissemination and unimpeded transmission platform
	Management of comprehensive safety monitoring and early warning (C_{17})	81.67	0.06162			Monitor in important places
	Area environmental management (C_{18})	78.33	0.05277			Clean, healthy, and timely sweeping.
	Passenger integrated service management (C_{19})	86.67	0.06162			Deal with complaints and solve passengers' demands immediately
	Vehicle management (C_{20})	85	0.06162			Parking orderly
	Area commercial activities management (C_{21})	80	0.05492			Standard commercial order
	Food safety management (C_{22})	79.33	0.05277			Supervise food health
	Fire control management (C_{23})	90	0.07428			Check fire facilities and make sure they are available
	Lighting management (C_{24})	90	0.07428			Light immediately in railway stations and their surrounding areas
	Noise management (C_{25})	81.67	0.06162			Management of noise source
	Outdoor advertisements management (C_{26})	81.67	0.06162			Orderly advertise
	Temporary engineering management (C_{27})	78.33	0.05277			Daily safety check

Emergency management（B_3）	Management of plans for meeting disasters（C_{28}）	85.33	0.1161	0.2080	87.8	All kinds of plans for meeting emergency should be complete and written according to provisions of the industry. Their contents should include each kind event's emergency measures, emergency equipments, processing modes and responsible persons. Coordination with local police, medical, traffic and other departments makes sure timely emergency response
	Management of plans for meeting unexpected environmental events (C_{29}）	93	0.1253			
	Management of plans for meeting dangerous unexpected events（C_{30}）	95	0.1551			
	Management of plans for meeting unexpected informational events（C_{31}）	74.33	0.0655			
	Prevention and response to terrorism（C_{32}）	91.67	0.1253			
	Prevention and emergency management of criminal offense（C_{33}）	84.33	0.1080			
	Prevention and treatment of group events（C_{34}）	81.67	0.0872			
	Organization and security of public activities（C_{35}）	90	0.1161			Make sure safe public activities
	Management of emergency handling resources（C_{36}）	83.67	0.1011			Complete emergency equipments

Table 2. Safety

Evaluation values	System safety levels
[0,60）	Unsafe
[60,70）	Basic safe
[70,90）	Safe
[90,100]	Very safe

Evaluation result of public places safety management of Xi'an Railway Station (A) is 84.8, which shows that current public places safety management level of Xi'an Railway Station is safe. Besides, evaluation value of infrastructures and environmental conditions (B1) is 83.5, daily management (B2) is 84.4, and emergency management (B3) is 87.8. Second class indicators' evaluation results are sorted as: B3>B2>B1, so in the view of current status of the square in front of Xi'an Railway Station, the score of emergency management is highest and its running state is best. According to the analysis of

each third class indicator, weights of power supply system in infrastructures and environmental conditions, fire-control management in daily management and management of plans for meeting dangerous unexpected events, management of plans for meeting unexpected environmental events and prevention and response to terrorism in emergency management are larger, as public places safety main control indicators. Thus, management and control should be enhanced to develop the level of entire safety management.

Evaluation results show that current safety status of the square in front of the railway station is safe, but there are still some weak links in entire safety system, such as the lower scores of escape route in underground space and its capacity, area environmental management and temporary engineering management. As a result, these items should be improved as the key points and dynamic tracking and evaluation analysis of each work in live safety management should be launched in order to realize continual development of public places safety management of the railway station.

5. Conclusions

(1) Based on the analysis of public places system safety features and hidden dangers of railway stations, combined with the actual situation of public places safety management of railway stations, public places evaluation indicators system of railway stations is constructed. Besides, aimed at every specific indicator, corresponding safety management and control requirements are put forward, and safety management system is perfected.

(2) AHP is used to get indicators weight values. Public places safety main control factor is obtained by analysis, which is considered as an important basis of improvement of safety management.

(3) Aimed at the current safety management status of Xi'an Railway Station, through experts' live scoring evaluation, according to evaluation results, recognize the weak links of safety management and put forward corresponding improvement measures in order to supply continuous improvement of public places safety management of Xi'an Railway Station with decision making basis.

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