Analysis of Causes of Railway Traffic Safety Accidents Based on Grounded Theory

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Abstract: Through the traversal of the hazard log and the application of grounded theory to mine text data, the three-level coding process discovers the causes of accidents above the higher risk level of the railway, and summarizes various factors theoretically, connecting the theory into a “story line” and establishing Two theoretical lines of factors were analyzed, and the core theory was found to be based on the safety management system. The theoretical line model explains the layers of causes from system to technology to human factors that lead to frequent railway accidents.

1. Introduction

Keywords: Grounded theory, Danger log, Railway safety incident, Safety management system

In recent years, with the increase of railway transportation volume and speed, safety accidents frequently occur, railway traffic safety has gradually entered the field of vision of people and society, and railway transportation safety has become an important task in transportation. The Railway Administration has established a more systematic and comprehensive safety management system and model through the research methods of accident recording and analysis, continuously optimizing management methods and supervision mechanisms, and adopting advanced science and technology to ensure the safety of railway operations.

According to data, most of the incidents above the level of major accidents in my country’s railways are recurrences of past accidents [1]. This is a huge test for railway emergency management. It is through simple accident records and single incidents. Research methods of repeated analysis are not enough to respond quickly and make decisions. This paper will analyze the causes of accidents above the higher risk level of railways through grounded theory, and conduct a systematic analysis of hazard identification through raw data such as railway yearbooks and hazard logs, and summarize the causes of accidents above the higher level of accidents. Provide theoretical support for subsequent decision-making responses.

2. Theoretical Basis

2.1 Hazard Log

The hazard log can also be called the hazard record book or the risk record book. It is a log that records all the hazards that can threaten the successful realization of the safety goal of the system. It is a dynamic data that consists of a record of risk events that occurred during the work process. The log The role of is to provide comparative information about risks used in risk analysis and system risk management. [2] Generally speaking, risk logs come from computerized databases in various industries, and some industries where digitalization is not popularized will be documented in the form of large risk databases in various industries.

2.2 Grounded Theory

Grounded theory is a qualitative research method. It is a method of establishing a theory based on the summary of empirical data, which is jointly researched by Columbia University scholars Anselm Strauss and Barney Glaser. Researchers generally do not establish theoretical hypotheses, but summarize and summarize them through the experience of a large amount of original data, and eventually rise to a systematic theory. [3] Grounded theory was first applied to the field of medicine. In the 1960s, Glass and Straw conducted field investigations on the subject of medical staff dealing

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with dying patients in a hospital, and collected data through a large number of visits and observations. From the perspective of actors, it expounds the social behavior and psychological control theory of medical staff in dealing with dying patients. With the continuous emergence of social problems, grounded theory has been continuously applied to the field of sociology, psychology, manufacturing, transportation and other fields for theoretical construction.

Grounded theory uses three-level coding for data traversal and keyword extraction [4]. The first-level coding is also called open login. It uses questioning methods to mine concept categories from the data, name the categories and define the categories. For the attributes and dimensions of the genus, this level will extensively traverse the collected original data for analysis, but all the explanations here are preliminary and undetermined. The secondary code is also called associative landing or axis landing. The categories derived from the primary code are extracted, and each time only one category is analyzed in depth, the primary and secondary categories are distinguished, and the original data are recombined. , Discover and establish connections between various conceptual categories. The three-level coding is also called core type landing or selective type landing. A core type is selected through systematic analysis among all the types found, and the subsequent data analysis is performed around the core type.

After three levels of coding, the core category that needs to be upgraded to the theory is obtained, and the data and concepts are constantly compared, and systematic questions related to concept generation are systematically asked to establish the connection between the concept and the concept, so as to develop the theoretical concept. The constructed theory should have the characteristics of high density of previously extracted concepts, high integration, and adaptability to concept variability [5, 6].

3. The Data of Accidents Above the Higher Risk Level of the Railway Take Root

Through the collection of railway major risk level accident hazard logs, 36 accidents with risk levels above the greater risk level were screened out, and 78 railway risk logs were traversed to filter the collected data according to the following criteria:

(1) Delete accident cases with risk levels below the greater risk level;

(2) Delete accident cases where the cause of the accident cannot be analyzed and the cause of the accident is unknown after the accident investigation;

(3) Delete the periodic analysis of different stages of the accident conducted by the same department;

In the end, 36 effective risk analysis cases were obtained, and the major risk accident cases were divided into hazard description, hazard location, hazard cause, hazard occurrence time, possible hazardous events, consequences, and risk levels of each risk log (Table 1) elements Perform text traversal.

Table 1 Hazard Log Data Table of Accidents Above the Higher Risk Level of Railway

Number	Hazard description	Hazard	Cause of danger	Time of danger	Possible dangerous event	Result	Risk level
1	The 2404 train and the 301 wagon on the Jinpu line clashed head-on	Nanjing Huaqiying Station	The switcher made a mistake in operation. The passenger car stopped 301 times in 1 unit. After 12 times and 2 units were driven	1950.1.23	Cause the subsequent train to be delayed, affect the normal operation of the train, and affect the normal operation of other sections in	Death: 16 people Injured: 46 people, 2 steam locomotives were scrapped, driving was interrupted for 12 hours and 29 minutes	Major accident

			out, the switcher arbitrarily shifted the switch to 1 unit and drove 301 times.		the station		
...	...	...	...	...	...	...	...
34	D301 (Beijing South-Fuzhou) on the Hangzhou-Shenzhen Line	Wenzhou City, Zhejiang Province	The train control center equipment design flaws, lack of strict inspections, and weak emergency response to lightning strikes	2011.7.23	The subsequent train stops and waits	Death: 40 people Injured: 210 people	Particularly serious accident
35	Two trains collided at Yuyuan Road Station	Shanghai Yuyuan Road Station	The old west gate of Shanghai Line 10 due to signal failure in Xintiandi	2011.9.27	Cause subsequent trains to fail to operate normally	Death: unknown. Injured: 271 people	Particularly serious accident
36	The collapse of the railway bridge in Tianjin	At k4+300m	Bridge in disrepair	2020.11.1	Line interruption	Death: 8 people Injured: 1 person	Major accident

Analyze the data in the risk log through grounded theory.

(1) Open code

In this paper, through the in-depth analysis of accident cases and the in-depth exploration of the causes of railway safety accidents, the coding method adopted is: case serial number-keyword row number-keyword byte number. For example, 1-1-1 indicates that the case number is 1

In the “Jinpu Line 2404 train and 301 wagon head-on collision” accident, the first byte of the first row where the keyword of the accident reason is located, through the repeated sorting of bytes through open coding, finally extracted 76 preliminary cases from 36 cases Categories and 189 concepts, the specific operation results are shown in Table 2.

Table 2 the Categories And Concepts of Open Coding

Number	Preliminary category	Concept
1	Operation error	Wrong turnout (1-4-142), …, wrong entry signal (24-5-278)
2	Facility failure	The semaphore is disabled (1-3-99),...
…	…	…
76	Security check operation is not strict	Carry flammable substances (2-16-38),...

(2) Spindle coding

Perform cluster analysis on the obtained preliminary codes and concepts, deduced the main categories of the causes of railway traffic safety accidents from the mutual images and logical relationships of the concept categories, and summarized 76 initial categories into technical factors, personnel psychology, etc. 10 Then, the 10 main categories are summarized and summarized, and finally three categories are formed: railway operation safety regulations, railway equipment and technical problems, and railway labor problems, as shown in the following table.

Table 3 Main Categories And Relationship Categories

Number	Relationship category	Main category	Category
1	Railway safety regulations	Skills requirement Application scenario Safety training plan Division of Responsibilities	On-site operations are not in compliance, responsibilities are out of bounds, security awareness is not strong,...
2	Railway equipment technical issues	Information transfer Facilities hardware Overhaul	Facility failure, maintenance time does not meet the requirements,...
3	Railway labor issues	Work system Psychological factors Physical factors	Operation error, lax security check operation, work fatigue, work slack,...

(3) Select the code

It is mainly aimed at further building the relationship between the main categories, building the core categories in the main category, and constructing the corresponding theory. The theoretical line of this theory is the railway safety regulation problem-railway equipment technical problem-railway labor problem, which is found through analysis Most of the railway accidents that result in the end are based on human operations, and go back to the surface problems of railway equipment and dig deep into the problems of the railway safety management system. Through the system step by step, a theoretical line that ultimately affects human behavior and psychology reveals the technical requirements, application scenarios, safety training, and division of duties in the railway safety regulations.

4. Model Interpretation

(1) Railway safety regulations issues-railway equipment technical issues

In the role path of railway safety regulations-railway equipment technical problems, the details of the regulations require all departments in charge to carry out equipment maintenance and replacement in strict accordance with the time node. However, due to the insufficiency of equipment technology, various equipment replacements are not timely and seriously affect normal driving. Use; In addition, the system will organize employees to conduct regular safety training, but due to the difference in venues and working hours, the training time is not compromised, which seriously affects the establishment of safety awareness and safety precaution training; it is stipulated in the “Technical Regulations” The requirements of one look, two fingers, and three confirmations were not well and strictly supervised during the implementation process [7, 9], and could not be applied to work scenarios well.

(2) Railway equipment issues-railway labor issues

Due to the slow update speed of railway equipment, a large amount of manpower is used, which requires a lot of manpower to carry out on-site practical operations, which increases the workload of laborers; in the work system, the work system through shift system and rest time organization and study seriously affects the normal work of laborers. Rest, which causes frequent railway safety problems caused by burnout at work. Analyze from two aspects of human psychology and physiology[8]. Through extensive text analysis and field research, we understand that employees’ rest is not fully guaranteed. , The frequent occurrence of occupations of employees’ rest time for other work arrangements leads to inability to concentrate their attention well during normal working hours, resulting in railway accidents, backward equipment and inflexible systems all lead to employees’ work pressure is too big.

5. Conclusions and Prospects

This paper uses grounded theory and risk log traversal, through the rooted three-level coding layer to cluster, analyzes the cause of railway accidents above the higher risk level and connects theoretical lines, connects independent influencing factors, and establishes the railway Safety regulatory issues-railway equipment technical issues-the theoretical line model of railway labor issues, based on the independent analysis of the various factors of the previous research to the

theoretical line formed in this article, it is found that the influencing factors are both independent and interrelated. Model railway regulations problem-railway equipment technical problem path analysis and railway equipment technical problem-railway labor problem path analysis, explaining that railway safety regulations affect the human factor level and lead to the frequent occurrence of railway safety accidents.

However, the following problems still exist for the research:

(1) Although the data traversed by the risk log is representative, the amount of analyzed data text is not large enough, and the risk log text data will be further expanded in the future;

(2) The expansion of future research data will result in further expansion of the main category. Today's research is not particularly extensive in terms of reason analysis;

(3) The connection lines between theories should be more clear in the process of selecting codes;

(4) The later thesis research will add cluster analysis to the cause, establish big data mining to form decision-making solutions and prevent railway safety accidents.

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