Technology in Society 43 (2015) 69–74

Contents lists available at ScienceDirect

Technology in Society

journal homepage: www.elsevier.com/locate/techsoc

Engineering accidents in society: A comparison of Chinese and American railway accident investigation

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ARTICLE INFO

Article history:
Received 31 January 2015
Received in revised form
20 May 2015
Accepted 24 May 2015
Available online 17 July 2015

Keywords:
Engineering accident
Engineering learning
Railway accident
Accident investigation
Institutional environment
China
US

ABSTRACT

Based on the investigation reports for two major railway accidents in China and the USA, as well as the analysis of related systems, this paper compares the differences between Chinese and American railway accident investigation modes along different dimensions. The four aspects attended to are the investigation purpose, institutional basis, scope and process, and type of conclusion. The results reveal the role of social factors in shaping the investigation pattern of engineering accidents, and show engineering accidents can serve as a window to understanding a society and the ways that learning from engineering accidents is a socially institutionalized process. A final discussion considers possible improvements that might be introduced into the Chinese mode of engineering accident investigation.

1. Introduction

Safety is the basic requirement of engineering activities. However, it is hard to avoid engineering accidents completely, notwithstanding good design, careful construction, and prudent operation [1]. Once accidents occur, there are recurring questions in engineering about how best to analyze their causes, to learn from them and develop appropriate responses, and to avoid similar accidents in the future. Here the engineering accident investigation is the first task [2] with its purpose being to collect accident-related evidence and information, to analyze and determine possible causes, and to propose specific measures to prevent similar incidents from happening again [3] [4]. Only the timely, independent, comprehensive, and objective accident investigation can lay the foundation for engineering learning [5] [6] [7]. Due to differences in cultural background and institutional environment, the accident investigation modes of different countries may differ considerable [8]. This article does not intend to comprehensively compare the different of engineering accident investigation modes in all countries; it simply makes a comparison of railway accident investigations in China and in the United States. The aim is to highlight some basic differences in engineering accident investigation modes between these two countries, thus illustrating that engineering accidents can serve as a window for understanding how learning from engineering accidents is a socially institutionalized process.

In recent years, there have been many railway construction projects in China [9]. By the end of 2012, operating railway lines totaled 98,000 kms, ranking second in the world, less than one half of the current operating kilometer, or the level of the year 1870, in the United States; high-speed railway lines totaled 9356 kms, highest in the world. Over the last decade, new high-speed railway construction in China has been greater than the whole rest of the world and will reach 18,000 kms by 2015 [10]. With the rapid development of the railway, accidents have also frequently happened. Since 1978, there have been 13 major railway accidents with more than 30 deaths each, resulting in a total of 987 deaths, 29 deaths each year on average.[1] The one high-speed railway project with the greatest length and largest investment was the Beijing-Shanghai line, which had six accidents during five days after it opened on June 30, 2011. Such frequent accidents raise serious

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[1] See, "Major railway accidents since the founding of the People's Republic of China", http://news.sohu.com/s2012/huocheshigu/; also see "List of rail accidents in China", http://en.wikipedia.org/wiki/List_of_rail_accidents_in_China.

http://dx.doi.org/10.1016/j.techsoc.2015.05.011
0160-791X/

doubts about high-speed railway technology and railway sector management [11], thus it feels urgent to promote the development of higher safety standard and engineering learning in China railway.

Compared with China, as the country with the longest railway operating mileage in the world, the United States [12] has had 42 major accidents with more than 30 deaths from 1853 to 1972, leading to a total of 2240 deaths, 19 deaths each year on average. Among which nine accidents occurred from 1946 to 1972, resulted in 425 deaths, 17 deaths each year on average [13]. Since 1967, when National Transportation Safety Board (NTSB) was established, it has seen only two accidents which resulted in more than 30 deaths: one is the collision of Illinois Central Gulf railroad commuter trains, killing 45 people and injuring 332, and the other happened on September 22, 1993 when the "Sunset" train fell from a railway bridge hit by a river barge resulted in 47 deaths.[2] Although it might seem that the railway system in the United States has a safety record far superior to that in China, the comparison is skewed by the fact that in America there has been very few passenger trains for decades. Most US rail traffic is freight. Although there are a good number of American train accidents each year, few lead to human injuries. Nevertheless, the United States has learned a lot from its railway accidents. In fact, the US railway accident investigation agency, NTSB, with extensive experience in accident investigation and mature accident investigation methods, is internationally respected. Indeed, the NTSB practices have sometimes served as models for accident investigation in other countries. Established in 1967, the NTSB is "an independent Federal agency charged by Congress with investigating every civil aviation accident the United States and significant accidents in other modes of transportation – railroad, highway, marine and pipeline." The NTSB exists to determine "the probable cause" of accidents and to issue "safety recommendations aimed at preventing future accidents" (NTSB web site). It does not attempt to determine responsibility for an accident, an issue which is left to litigation and the courts (This does not deny the importance of accident responsibility investigation; but for engineering learning cause is probably more important than legal responsibility). In accord with its mandate, the NTSB is further required to hold hearings within six months of an accident (although there may be delays for major accidents). Over the course of its existence the NTSB has proposed more than 10,000 safety recommendations on the basis of its investigations. Many recommendations were adopted by relevant departments, enacted as industry standards or policies, or became the basis of government legislation [14].

In the contemporary world, commentators outside China have paid particular attention to its high-speed railway constructions, sometimes in praise but sometimes criticizing its safety record. Chinese observers too have expressed interest in the American approach to engineering accident investigation. It will thus be useful to undertake a preliminary comparison of similarities and differences between American and Chinese railway engineering accident investigation processes.

2. Selection of railway accident cases in the United States and China

The present comparison focuses on "major engineering accidents". According to the provisions of Article 3 of China's Regulations on Reporting and Handling Production Safety Accidents (State Council Decree No. 493), production safety accidents are classified as four ranks: ordinary accidents are those that result in less than 3 deaths, or less than 10 serious injuries, or less than RMB 10 millions direct economic losses; sub-major accidents are those that result in more than 3 and less than 10 deaths, or more than 10 and less than 50 serious injuries, or more than RMB 10 millions and less than RMB 50 millions direct economic losses; major accidents are those that result in more than 10 and less than 30 deaths, or more than 50 and less than 100 serious injuries, or more than RMB 50 million and less than RMB 100 million direct economic losses; special serious accident are those that result in more than 30 deaths, or more than 100 serious injuries, or more than RMB 100 million direct economic losses. Very different from China, in the United States the Occupational Safety and Health Administration (OSHA) regards any accident as major that causes death, permanent or temporary loss of entire or partial capabilities [15]. In this paper, we intend not to argue the rationale of such ranking, rather, to focus on the manner in dealing with engineering accidents in both countries. For comparison, we simply define major engineering accidents as those result in more than 10 deaths, which include both major and special serious accidents in Chinese category. Because of the serious threat to persons, property, or the natural environment, major engineering related accidents have always been top priorities for accident investigation in both countries. In the present instance, comparison will be based on one major railway accident in the United States in 2008 and another in China in 2011.

The US railway accident to be referenced occurred in the Chatsworth neighborhood of Los Angeles, on September 12, 2008 (hereafter, the 9–12 accident), with a head-on collision between passenger train No.111 of Metrolink Railway and the LOF65-12 freight train of Union Pacific Railroad (UP). Local authorities (including the Los Angeles Fire Department) initiated rescue operations and the NTSB setup a 9–12 accident investigation team, which was quickly dispatched to the scene to oversee operations and launch an investigation. The on-site rescue operation lasted 22 h until the last victim's body was found. The event was one of the worst railway accidents in the United States in decades, resulting in a total of 25 deaths, 102 injuries and economic loss of more than US$12 million. In the accident compensation, Metrolink Railway paid out US$200 million to the victims, to the upper limit of compensation stipulated by law. Although no individual was punished, the train operating engineer who was suspected of causing the disaster by running a red light while using a mobile phone, was killed in the accident. The on-site investigation lasted a total of eight days and the entire investigation 16 months.

As an essential part of the accident investigation, NTSB held a hearing on March 3–4, 2009. All entities assisting and participating in the investigation sent representatives to attend the hearing—including the US Railroad Administration, the two railway companies (Metrolink and UP), the California Public Utilities Commission, the US Transportation Association, the American train drivers' union, the Los Angeles Police Department, Los Angeles Fire Department, and the vehicle manufacturer Bombardier, Mass Power Group. The purpose of the hearing was to collect testimony and evidence from accident eyewitness in a public way and to report the process and schedule of the accident investigation to the public. On January 21, 2010, NTSB president, A.P. Hersman, vice president, A. Hart, and member, L. Sumwalt, approved and released the 9–12 accident investigation report. (The NTSB is composed of five members serving five-year terms. But since NTSB responsibilities cover air, marine, rail, and some highway accidents, as well as pipeline incidents, not all five members take responsibility in all areas.)

The Chinese accident to be considered occurred on the Yong-Wen Railway Line on July 23, 2011, when train No. D301 crashed into the rear end of stationary train No. D3115 on a viaduct in the

[2] See the accident reports: http://www.ntsb.gov/investigations/AccidentReports/Pages/RAR7305.aspx; http://www.ntsb.gov/investigations/AccidentReports/Pages/RAR9401.aspx.