Human Factors Analysis of China WenZhou High-Speed Train Collision Accident

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On 23 July 2011, two [high-speed trains](https://en.wikipedia.org/wiki/High-speed_rail) travelling on the [Yongtaiwen railway line](https://en.wikipedia.org/wiki/Ningbo%E2%80%93Taizhou%E2%80%93Wenzhou_Railway) collided on a [viaduct](https://en.wikipedia.org/wiki/Viaduct) in the suburbs of [Wenzhou](https://en.wikipedia.org/wiki/Wenzhou), [Zhejiang](https://en.wikipedia.org/wiki/Zhejiang) province. The two trains [derailed](https://en.wikipedia.org/wiki/Derailment) each other, and four cars fell off the viaduct. 40 people were killed, at least 192 were injured, 12 of which were severe injuries. This major accident had a profound impact on the development of China High-speed Railway System. The essay will analyze the cause of this accident using five aspects of human factors analysis approach: individual, group, regulatory, environment and organizational.

Description of the railway accident

On July 23rd, 2011, at 20:30:05, the high speed train D301 from Beijing to Fuzhou collided with the D3115 train on the Yong-Tai-Wen High Speed costal railway line. Both D301 and D3115 were behind schedule and reached YongJia railway station at 19:21 and 20:12 respectively. At 20:14:58, D3115 was ordered to leave YongJia station and was notified to change its operational mode from decentralized autonomous control mode (DACM) to on-sight mode at TC-5829(railway section code) due to an error warning in TCC (Train Control Center) indicating the same railway section was occupied by another train. But sometimes an abnormality in TC (Track Circuit) may also lead to the same error code. When D3115 reached 5829AG at 20:21, due to the failure of the TC, it stopped automatically for nearly eight minutes and failed to restart until 20:29:26. After that it kept running at a speed of 16 km per hour under abnormal conditions. During the restart period, D3115 called the dispatcher six times and was called by the watch keeper three times, but all calls failed to connect.

Meanwhile, D301 was ordered to leave from Yongjia station heading to Wenzhounan station at 20:24 by the dispatcher in the CTC (Centralized Traffic Control). The information transmitted by TCC at Wenzhounan station, which grounds the departure of D301 was in fact erroneous. Because the data acquisition board in the TC had been destroyed by lightening at about 19:30 and failed to collect consistent information about the railway road occupancy. As a result, D301 was given the wrong signal indicating that there was no train in section 5829 and the signal lights in section 5818 and 5803 turned green. Consequently, D301 did not stop or decelerate at sections 5815 and 5803. At 20:29:32, when D301 reached TC-5829, it was notified to decelerate by watch keeper in Wenzhounan Station. Unfortunately the call was too late, and D301 rear-ended D3115 before the talk was over….. (Yun XiaoFan, Li, Jingjing, Li, & Sun, 2014)

Individual Factor

The operator of D3115 obtained his operating license on 25 Feb. 2010. His alcohol test was passed before the shift but it is found that he had been working long shifts over 12 hours without breaks in between.

The operation of D301 had limited training on the high-speed train operation and was lack of emergency operating training.

Group Factor

The China train operating system consists of drivers, dispatchers and watch keepers. The fault in the TCC equipment affected the dispatcher’s decision which leads to the wrong operation of the rest of team members. Due to the lack of proper safety management training, they both made mistakes either because they did not realize the hazards or did not know how to cope with them (Yun XiaoFan, Li, Jingjing, Li, & Sun, 2014).

Regulatory Factor

As the government regulatory agency, MOR (Ministry of Railway) was responsible for contractor selection, administrative examination and approval of related equipment. In order to achieve the rapid development of high-speed railway, the minister of MOR, without proper revision procedure, changed the accident railway sections construction specification from 200 km/hr to 250 km/hr. During railway construction, MOR was pushing the project process bypassing the quality audit.

Besides, MOR and its subordinate departments approved LKD2-T1 TCC equipment ignoring the potential serious failure. Further investigation found out the minister of MOR was directly involved with alleged under-table deals in procuring the faulty equipment. Arguable it is due to the political ambition of minster himself that the project was done in such a rapid fashion.

Environment Factor

It is no doubt that the weather was the triggering factor of the accident. According to the investigation report (Ministry of Emergency Managment of the People's Republic of China , 2011), abnormal lightning activities was recorded by Environment China on that day. Over 340 times lightning was observed. It is believed that the severe lightning from 19:27 to 19:34 caused the fault in the LKD2-T1 TCC equipment.

Organizational Factor

It is also believed that the overly rapid development of high-speed railway contributed to this accident. China was trying to lead the world in its high-speed railway technology. Many of the improvements were achieved at the cost of safety. The faulty control system was developed by China Railway Signal&Commnication Corporation (CRSC) - a state-owned company. This complex system should be developed under scrutiny to ensure the safety standard is met. However, under the initiative of rapid deployment encouraged by MOR, the design and development of LKD2-T1 TCC was done in a hurry. Also with no previous industry experience, CRSC has to use “try and error” approach in its R&D process.

According to Ministry of Emergency Managment of the People's Republic of China, SRB (Shanghai Railway Bureau) responsible for the dispatching of trains in railway sections where accident took place failed to implement the safety regulation regarding emergency management and provided little training to its staff.

This major accident put a halt to China’s over-heated railway construction project and had an irreversible impact on China railway industry amid China’s ambition to export its high speed railway technology. People can simply blame on poor weather as the cause of the accident but the underlying lack of “safety first” attitude across various individual workers and organizations is the true culprit. In fact the accident could be avoided had MOR put safety into first priority in making polices, regulations and not push its subordinates to achieve the goal in unrealistic pace.

# References

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