RTRI Method of Accident Analysis

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Japanese railways strive to prevent accidents by analyzing causes of various accidents, including even such minor ones as the failure of a train to stop exactly at a prescribed position or the delay of a train by only a few minutes. At present, however, there are several cases in which the causes of accidents, especially those involving human factors, are not analyzed satisfactorily. This is due to the fact that in analyzing the causes of those accidents, field managers at the operating sections and facility/electricity sections who are not experts in analysis resort in a large measure to their experiences, rather than analytical techniques. As a matter of fact, the existing analytical techniques, such as fault tree analysis (FTA) and variation tree analysis (VTA), are so sophisticated that they can hardly be used by non-experts in accident analysis. In the present study, therefore, we developed a new method that permits even non-experts in accident analysis to easily and accurately analyze the causes of accidents which involve human factors.

The newly developed method, which is based on the concept of root cause analysis, is an integrated analysis system combining simple techniques to analyze an accident in three steps: (1) analysis of deviations, (2) investigation of causes of deviations and (3) identification of problems.

The first step—analysis of deviations—is to clarify events which deviated from the normal course of events during the accident. For this type of analysis, VTA has often been used. For the new method, however, we worked out a time-serial collation analysis technique to facilitate the analysis of deviations. In this technique, the "normal flow of events" (i.e., the way the work should have been done) and the "flow of events during the accident" are tabulated on a time-serial basis (Table 1), and any differences between them are regarded as deviations. This technique, though simple, has a marked advantage in that it clearly reveals any deviation as a difference from the normal course of events.

The second step—investigation of causes of deviations—is to reason the causes of the individual deviations clarified in the first step and the origins of those causes. In this step of analysis, we apply a cause-down analysis approach whereby the causes of the deviations are determined by a successive series of questions (Figure 1). For the purpose of this analysis, we also prepared a "human factor guide" which tabulates a chain of interrelated human factors to help reason out the causes of deviations involving those human factors.

The third and last step—identification of problems—is to clearly identify problems revealed in the above two steps. In this step of analysis, a table of multiple viewpoints based on an m-SHEL model is used (Table 2).

These new techniques have made it possible for non-experts in analysis to easily and properly analyze the causes of various accidents in the field.

Table 1. Example of time-serial collation analysis

(a) Course of events during accident	(b) Normal course of events	(c) Deviation
The driver started inspection before departure from depot.	The driver started inspection before departure from depot.	④
The driver completed the inspection.		
The driver checked the time.	(The driver checked the time.)	
The driver waited at the driver's desk till the departure time came.	The driver completed the inspection.	③
	The driver waited at the driver's desk till the departure time comes.	
:	:	:
	(The driver called out the aspect of the go signal for Track No. 1.)	⑦*
The train ran beyond the go signal for Track No. 1 despite the stop aspect.		**Accident**

Table 2. Examples of problems identified by multipoint analysis and corrective measures

Viewpoint	Problem	Corrective Measure
Management	Company policy overly focused on efficiency	Give the driver a clear-cut instruction as to things to be done without delay and those to be done safely.
Procedures	Driver thought that in most cases things would go alright without accurately performing the inspection before departure from depot.	Clarify relevant points at the depot and let problems occur if the inspection is not performed accurately.
Equipment	There were insufficient arrangements which reminded the driver that he should check the departure time when starting the train.	Install a clock which displays the current time at the touch of a button and make the system remain inactive unless the button is pushed.
Environment	Driver thought that no one knew if he did not do finger pointing and call accurately.	Make the driver visible and audible from the passenger room and let the correct manners of finger pointing and call known to passengers.
Personality	Driver had an inclination toward excessive efficiency.	Give the driver suitable instructions periodically.
Human relations	Driver thought that no collea gues knew if he did not do finger pointing and call accurately.	Let colleagues warn the driver of negligence.

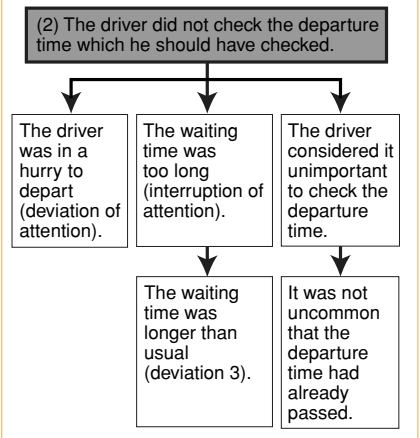

Figure 1. Example of cause-down analysis using "human factor guide" (only part of map is shown)