Safety Management and Resilient Work Performance at the "Sharp End"

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Profile

- Ph.D. in Psychology
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- Completed master's course at Kyoto University Graduate School (major in psychology) in 1977.
- Joined Japanese National Railways where he was involved in research on psychology and human factors regarding railway safety at the Railway Labour Science Research Institute and the Railway Technical Research Institute.
- Transferred to the School of Industrial Engineering, Department of Engineering, Tohwa University in 1995.
- Transferred to a post at Department of Psychology, College of Letters, Rikkyo University where he took up his current position in April 2006.

Dr. Haga specializes in industrial psychology, transportation psychology, and ergonomics. In addition to university education/research and academic conference activities, he also hold posts as member of the experts' committee for work procedure improvement at the Japan Transport Safety Board, external safety assessor at Kitakinki Tango Railway, member the safety research promotion committee at JR West, safety advisory group member at Japan Airlines, and safety advisor at Keio Corporation.

1 Is Keeping Accidents from Happening Enough?

The transportation system of railways exists not for the purpose of safety itself. Railway operators exist for the purpose of moving people or goods to a destination or to provide service where the process of that movement—travel—is a wonderful experience.

Those purposes are not achieved if an accident occurs, so accident prevention is without a doubt a top priority objective. Even so, it is not sufficient to simply keep accidents from occurring. Maintaining performance of the system of railways at the optimum level and raising that to the maximum level should be made to be objectives. In other words, just keeping accidents from occurring alone should not be the purpose of safety management.

Let's consider what safety management for achieving this purpose should be and what sorts of measures are required. At first, however, I would like to start the discussion by looking back in history at how safety management has dealt with the risk factor of human error.

2 From Human Error to Organizational Error

2.1 The Old View of Human Error

Common risk factors in modern industry and transportation systems such as railways include human error, equipment failure, natural disaster, crime, and terrorism. Of those, human error is an internal factor within the operator, so accidents occurring because of that bring about social condemnation and the operator faces grilling on accountability. Looking further into the cause of equipment failure also frequently leads to the discovery of human errors as having caused the failure.

The old view of human error includes the following:

(1) Human error occurs due to lack of attention. (No mistakes will occur if sufficient attention is paid.)
(2) Only some people cause errors to happen. (People who cause errors are lazy or not apt for the job.)
(3) Everything will go right if the specified work is done in the manner specified. (Anything other than those specified must not be done.)
(4) Punish violations and mistakes severely, and they will no longer occur.

If safety management is carried out based on this view, measures tend to be oriented toward screening only "safe people" by aptitude tests, limiting their actions by manuals and standard operating procedures, and punishing employees who make mistakes. Railways have traditionally been good at such safety management, and it certainly has contributed to the safety of Japan's railways. However, an organizational culture that emerges in this way has no flexibility, leading to it becoming very rigid in its ways. Above all, we have reached the limit to accident reduction by this type of safety management.

The airline industry has developed new education and training techniques such as crew resource management (CRM) based on the concept of human factors that will be explained in the next chapter. Efforts have paid off in minimizing errors while making the most of the abilities of individuals and teams.

2.2 Systems Approach

The concept of systems approach has spread since about 1980, and errors came to be considered something that "happens" in a human-machine system rather than being "caused by an individual". Here, "human error" is defined as "human performance deviating from the acceptable limit set by the system". The system here is a human-machine system where humans and machines work together. In designing the system, roles between human and machine are assigned and the duties and performance levels that the human side should achieve are defined. Human error is the phenomenon where the human side fails to fulfill those standards and system functions are deteriorated.

In this thinking, human error can be seen as the result of problems in design and operation of a system, including human, machine, and the relationship between them. The SHEL model neatly illustrated that idea (Fig. 1).

Fig. 1 SHEL Model
S=Software, H=Hardware, E=Environment, L=Liveware

Typical views of errors in the systems approach are as follows:

(1) Human error is not the cause of failures. It happens as a result of problems in deeper areas.
(2) Tools used, equipment, machinery, work procedures, methods of communication, work environment, time pressure, and the like are factors related to the occurrence of human error.
(3) Human error is not a conclusion of accident investigation. Rather, it is the starting point for investigation.

As with the "5 Whys" technique, an important issue in safety management is to look upstream from the error that is the direct cause triggering an incident to find the risk factors in the background and prevent reoccurrence of the incident by removing those factors. Incident and near miss reports are encouraged, enabling measures to be taken before an incident occurs.

2.3 Attention on the Organization

Accidents where the problem lies in the organization came to be topics of interest as a result of the 1986 Chernobyl nuclear accident and explosion of the space shuttle Challenger. The term "safety culture" was defined and that came to be emphasized as an accident factor from a report on the Chernobyl accident by International Atomic Energy Agency. Japan was initially believed to already have a world-class safety culture, so the topic did not receive much attention. However, it suddenly came into the spotlight with the 1999 nuclear criticality accident at the Tokaimura atomic fuel processing facility.

British psychologist and expert in human error research James Reason published *Managing the Risks of Organizational Accidents* in 1997, wherein he stated that an organization needed four elements to create a safety culture:

(1) Reporting culture
(2) Just culture
(3) Flexible culture
(4) Learning culture

The organizational approach to safety management has paved the path to research in investigating and analyzing the features of "high reliability organizations" that achieve safe operations in high-risk areas.

Fig. 2 shows the three types of safety management overviewed up to this point. Note that one did not succeed another; all remain important concepts in safety measures even today.

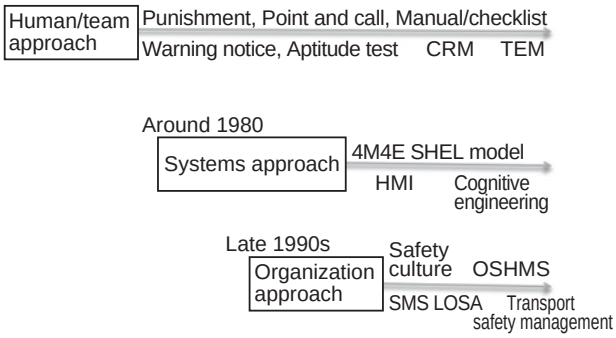

Fig. 2 Change in Error Management
CRM: Crew Resource Management; TEM: Threat and Error Management, 4M4E: Man, Machine, Media, Management, Education, Engineering, Enforcement, Examples; SHEL: Software, Hardware, Environment, Liveware; HMI: Human-Machine Interface; SMS: Safety Management System; LOSA: Line Operation Safety Audit; OSHMS: Occupational Safety & Health Management System

3 Resilience Engineering

3.1 Importance of Flexible Culture as Proved by Earthquake Disaster

The March 11, 2011 earthquake that struck the Tohoku region and the subsequent tsunami caused great damage across eastern Japan. After the earthquake, JR East crews guided passengers of 27 trains to tsunami shelters. Some of the crews were not able to receive instructions from dispatchers by radio, but they evacuated based on information from passengers and their own judgment. The tsunami wiped out five trains that had stopped in coastal areas, but everyone had already evacuated by that time. At one train, which had stopped at an elevated area, the crew started to evacuate passengers as instructed by the dispatcher, but subsequently decided passengers should stay where were based on the advice of local residents that the current location was safer. That decision saved them from a disastrous fate.

The crew of a helicopter of the Japan Coast Guard based at

Sendai Airport took off to avoid flooding after a tsunami warning was issued. They were unable to return to their flooded base and took on rescue duties round the clock without receiving orders from their base or commander due to inability to communicate by radio or telephone.

Ishinomaki Red Cross Hospital immediately suspended outpatient treatment after the earthquake in anticipation of a large number of people being delivered by ambulance. By the time the first patients arrived, the entire hospital was already in emergency response mode that crossed the boundaries of individual departments. A week after the earthquake, teams of doctors and nurses visited evacuation centers to reduce the number of infectious disease patients, working to improve the hygienic situation. It went beyond the role of a hospital in "treating patients who come to the hospital" as the staff believed their intrinsic duty was to care for the health of the refugees.

There were many other cases where offices in the Tohoku region got moving before receiving instructions from the head office or divisional headquarters. Those included Lawson convenience store, which immediately provided bottled water to evacuation centers, and delivery company Yamato, which delivered relief supplies free of charge. On the other hand, there were also many organizations and people who prevented activities of rescue and support due to a preoccupation with laws, regulations, customs, and precedent.

The following three points are seen in common by organizations that worked well in time of crisis.

(1) They had worksites with flexibility in thought and ability to act according to the circumstances.
(2) The local organizations and individuals acted autonomously and spontaneously based on their own decisions rather than in a top-down manner.
(3) The front lines understood the mission of the organization and acted accordingly.

These are precisely the elements of safety culture that James Reason called "flexible culture". Reason stated the following about flexible culture.

(1) Flexibility of an organization is having a culture that can efficiently adapt to changing demands.
(2) A high reliability organization has ability to switch from management by centralized authority to management by distributed authority.
(3) The point of flexible culture is transfer of authority to the front lines in emergency situations.
(4) Values shared in advance decide success or failure of the delegation of authority.

If the values of the organization as a whole (its mission and philosophy) have caught on with people working in local organizations and on the front lines, the front lines can make correct decisions in a crisis and act autonomously without hesitation. Reason sees those characteristics as supporting high levels of safety at high reliability organizations, and I believe that was proven in the Tohoku earthquake and tsunami.

3.2 Paradigm Shift of Human Factors

In conventional human factors, humans are considered to be components of the system, and emphasis was put on taking measures so mistakes on the human-side (human error) do not deteriorate system performance. However, a new research group came into being in around 2004, which claimed that resilience of humans and organizations is what maintains system performance. This concept became a major trend that has continued to today. They named their idea "resilience engineering", and the basic ideas of that are as follows. Of those, the contents of (1), below, are very close to the idea of "flexible culture" of James Reason.

(1) The system is inherently dangerous, and flexibility of humans and organizations makes the system function safely in changing situations.
(2) More attention should be paid to cases of success than failure, and effort should be put into increasing successes rather than decreasing failures.
(3) Measures to raise resilience of the organization are important for securing safety.

Resilience engineering had a major impact on researchers and practitioners in Japan too, and research and development on specific measures are underway in the fields of aeronautics, railways, electrical power, and medicine.

3.3 Safety-I and Safety-II

Erik Hollnagel, one of the advocates of resilience engineering, proposed a change in the concept of safety from a "situation where accidents do not occur" to a "situation where successes continue". He called the first "Safety-I" and the latter "Safety-II".

Safety management with an objective of Safety-I aims to avoid things going wrong. Causes of failure are sought out, and those causes are removed to prevent failure from reoccurring. Safety management with an objective of Safety-II, on the other hand, aims to maintain a high level of performance demanded in changing situations. It focuses on the everyday practice to know what the front lines should do to ensure as much as possible goes right and flexibly adjust so as to maintain a balance between safety and productivity. It also seeks to further the possibility for maintaining that balance as well as find potential risks and take countermeasures proactively.

Under Safety-I, effort is put into deciding rules to prevent failure and making sure they are followed. Violations are reproached strictly, and penalties are placed on those who make violations. Safety and productivity become opposing goals, and there is pressure to make an either-or selection of safety or production. When failure does occur, one is accused in hindsight of putting priority on production rather than safety. Safety management of Safety-II should support the front-line efforts of trying to secure safety under the pressures of production and efficiency.

Manuals are convenient tools for securing a certain level of safety. However, safety cannot be maintained by manuals alone. Under the thinking that manuals should be made for everything and that those manuals just need to be followed, people on the

front lines will no longer think for themselves; they will lose pride in their work and lose motivation, resulting in employees who do not follow manuals when not supervised and are not able to make decisions on what to do when decision-making is most needed.

4 Safety Management and Resilient Work Performance at the "Sharp End"

4.1 Safe Actions Spurred by Pride in Work

Recent survey research I conducted with my colleague Hana Oya has clarified that having pride in one's work (occupational pride) raises awareness of increasing efficiency and quality and also supports an autonomous attitude of safety, leading to intention to act safely (Fig. 3). Moreover, research is starting to clarify that occupational pride is influenced by the feeling that one is being treated justly by the organization. In other words, it is influenced by sense of organizational justice.

Here, we again saw an element of Reason's safety culture: just culture. In a just organization, wages and bonuses are distributed fairly, information and explanations are provided to the front lines as well, requests of the front lines are taken into consideration in managerial decision-making, and rewards and punishments are given justly.

If failures that occur when people are working faithfully and making an effort to meet the demands of the organization are punished severely by hindsight, employees at the front lines will not see the organization as being just. I thus believe there is a necessity here for so-called "policy of no punishment for human errors".

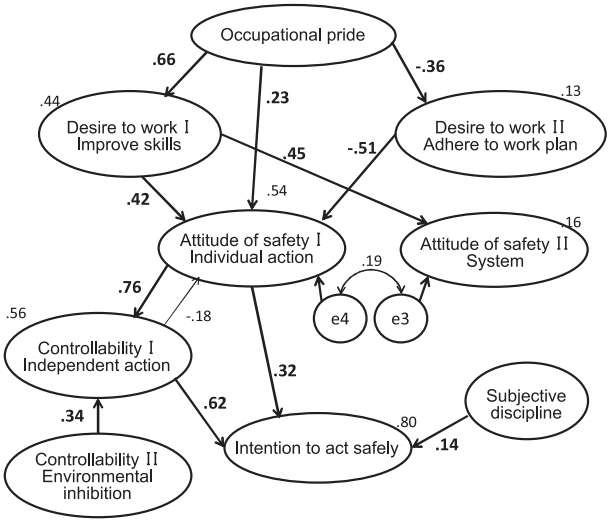

Fig. 3 Causal Model from Occupational Pride to Intention to Act Safely

4.2 Creating Resilient Work Performance

I believe that conditions for resilient work performance are the following:

(1) Front line employees spontaneously follow manuals.

(2) Front line employees can take self-motivated actions that they feel are necessary for safety and quality not covered in manuals.

(3) Front line employees and organizations can make decisions and actions necessary to fulfill the organization's social mission while securing safety even without instructions from above.

Such work performance requires that (1) front line employees have hope for a brighter future and are able to work with pride, (2) they are able to think and decide on their own, and (3) just rewards and punishments are given without being punished to take responsibility for consequences. But most of all, safety management must be practiced based on understanding of the actual working situation at the "sharp end".

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