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Capt. Akira Ishibahsi

Daisuke Karikawa

Toshio Wakabayashi

Makoto Takahashi

Masaharu Kitamura

DEVELOPMENT OF PROACTIVE SAFETY MANAGEMENT SYSTEM FOR INDUSTRIAL FIELDS BASED ON THE FRAMEWORK OF AVIATION SAFETY REPORTING SYSTEM

Capt. Akira Ishibahsi
Graduate School of Engineering, Tohoku Univ.
Sendai, Japan
Daisuke Karikawa, Toshio Wakabayashi, Makoto Takahashi and Masaharu Kitamura
Graduate School of Engineering, Tohoku Univ.
Sendai, Japan

The safety reporting system such as the Aviation Safety Reporting System (ASRS) draws attention from various industrial fields as an effective safety management method to prevent further accidents. However, it became apparent that the industrial fields often confront the difficulty of the development and effective operation of safety reporting system due to the differences between aviation and other industrial fields. In this study, an effective safety reporting system for practical use in a conventional industrial field has been developed based on ASRS. Although the detailed evaluation of the proposed safety reporting system is still underway, its effectiveness has been strongly implied through the actual utilization as a proactive safety management system of a construction company.

In order to enhance the safety of public transportation, Japanese Ministry of Land, Infrastructure, Transport and Tourism (MLIT) issued a mandatory requirement for all service providers of public transportation to introduce Safety Management System (SMS), based on the lessons learned from the Aviation Safety Reporting System (ASRS). The safety reporting system also draws attention from other industrial field as an effective safety management method to prevent industrial accidents. However, it has become apparent that the industrial fields often confront the difficulty of the development and effective operation of proactive safety management system. In general, the safety reporting system in aviation area is operated by the government with ample budget and human resources. The collection and analyses of safety information are performed by many concerned parties. On the other hand, in most of the conventional industrial fields, a company is required to establish and operate safety reporting system within limited resources from collecting information to formulating safety measures based on the analysis of the acquired information. Research and development activities taking such differences between aviation and other industrial fields into consideration are certainly required to apply SMS developed in aviation field to other conventional industrial domains.

In this study, the essential issues to be considered to develop effective safety reporting

system for practical use in a conventional industrial field have been discussed based on the extensive application experiences. The target field of the safety reporting system tackled in this study is not only transportation area but also manufacturing industry, construction, nuclear power plant and space development industries.

Method

In order to apply the safety reporting system to conventional industrial fields with various differences from aviation area, the authors have developed a modified safety reporting system called the Industrial Safety Reporting System (ISRS) based on ASRS. The conceptual scheme of ISRS is summarized in Table 1 as contrasted with one of ASRS. The point is that required human resources for system operation of ISRS should be reduced compared with ASRS because available resources for safety activities are very limited in many industrial fields

Table 1. Conceptual scheme of ASRS and ISRS

ASRS	Industrial Safety Reporting System
1) Basic Principle	***1) Basic Principle***
Voluntary, Confidential, Non-punitive	Voluntary, Confidential, Non-punitive, Field-oriented
2) Reporter Protection	***2) Reporter Protection***
Immunity (assured by formal documents) Confidentiality and De-identification	Non-punitive to the reporter Separation from personal evaluation De-identification after completion of hearings
3) Transparency of the System	***3) Transparency of the System***
Clarification of Responsible official Clarification of Objectives and Operation	Clarification of Responsible official Clarification of Objectives and Operation Clarification and Publicity of Submitting Procedure
4)Organization and Operation	***4)Organization and Operation***
Secretariat Report processing, Root cause analysis, Callback, Countermeasures and Recommendation, Publication	Secretariat, Project team Report processing, Root cause analysis, Hearings, Risk assessment, Countermeasures, Publication of case list Improved reporting format to simplify data entry work
5)Feedback	***5)Feedback***
Statistical report, Callback, Quarter report, Quick actions etc.	Statistical Report (1 page), Poster, Case list, Notice letter
6) Promotion	***6) Promotion***
Certificate of receipt, Appreciation letter	Kick-off campaign, Safety forum or Workshop Incentive awards (from¥1000-¥10,000), nickname of system and slogan (“Near-incident is a present by angels”)

compared with ones in aviation. For example, reporting format of ISRS are designed to simplify data entry works into the incident database so that staffs without domain knowledge can perform the works easily and smoothly. In addition, because the know-how to analyze near-incident reports and to develop countermeasures based on the result of analysis is not so common in conventional industrial companies, effective analytical methods of collected reports should be provided as a part of the framework of safety reporting system. Promotion activities are quite important for developing shared understanding of non-punitive and non-disparage principle of a safety reporting system which can significantly affect its feasibility in a company. One of the effective ways for such kind of promotion activities is to give a friendly nickname or a catch-phrase to the safety reporting system such as "A near-incident is a present by angels".

Application

ISRS has been applied for safety enhancement activities of Company T. The domain of Company T is maintenance for electrical power plants. Company T has 1,310 employees and also has 4,000 employees of subcontractors. For enhancing safety in the company, one of the authors has worked with them for introduction of ISRS from the year of 2006. This chapter summarized the process and result of the application of ISRS in an actual field as one of the examples of the ISRS application to the conventional industrial domains.

Introduction of ISRS

Before introduction of ISRS, Company T had the original safety reporting system gathering employee's safety report by a questionnaire format. However, the original safety reporting system failed to gather useful information and ISRS has been introduced as the renewed company's safety management system since April 2006. The overview of the introducing process is described in the following.

Table 2. Criteria of Risk Quantification in ISRS

Evaluation Points	Risk Quantification (Calculation of Risk Score)
1) The number of past reports about similar near-incidents	The risk score is added 1 point for each past report. (The max additional score is 6 points.)
2) Frequency of the work involving the risk	Daily: +4 points. Every work period: +2 points. Rare: +1 point.
3) Anticipated damage	Virtually-undamaged: +1 point light injury: +5 points Fatal & serious injury: +10 points

Establish secretariat and project team. A group manager has been assigned as a responsible official. Two newly-employed part time stuffs were appointed as administrators of the near-incident database. In addition, project team was organized in each regional office as back-up team for the secretariat. The secretariat has wide and important roles as listed below.

receive and analyze reports / conduct hearing investigations / conduct the risk assessment of reported near-incidents / develop countermeasures / give feedback to company members / produce case list

Improve the near-incident database. New near-incident database system has been installed. The permission to access the database has been given to everyone in the company. Management works of the database has been performed by the secretariat.

Improve the reporting format. Reporting format has been changed to a new format with high compatibility with the near-incidents database system. It contributed to reduce the burden of data entry works into the database.

Give a Nickname to ISRS. In order to familiarize company members with the proposed safety reporting system, the slogan "A near-incident is a present from angels" was decided. The reporting format was also named "Experience note of angel's present".

Introduce the incentive award. In order to collect as many as experiences of near-incidents from workers, the institution of the incentive awards has been introduced. A reporter has been given the reward from 1,000 yen to 10000 yen based on the contribution of her/his report to the enhancement of safety.

Analysis and Utilization

As a part of ISRS, the methods for analysis of collected reports and for utilization of the result of analysis have been provided to the company. This is a very important point because the know-how for analysis and utilization of the safety reports is not so common in the conventional industrial fields. The standard process for analysis and utilization in ISRS is described as follow:

1. Case analysis. In order to reveal the root cause and background factors of the near-incidents, the collected reports are analyzed by the secretariat from the view point of human factors. M-SHEL model and Variation Tree Analysis (VTA) are utilized as standard analytical tools in Company T

Table 3. Risk Level

Risk Level	Risk Score (cf. Table. 2)
Level 1 (negligibly-small)	1 - 3points
Level 2 (acceptable)	4 - 7points
Level 3 (should be reduced)	8 - 11points
Level 4 (should be immediately reduced)	12 - 20 points

Table 4. Quick reference matrix of countermeasures effectiveness

Type of Countermeasures	Effectiveness
Remove the safety risk	7 points (Ex. Using safety belt in high-place work、Put up safety net, improvement of construction method
Decrease the safety risk by improving manner of operation	4 points (Ex. assignment of safety observer)
Cautionary notices about the safety risk	2 points (Ex. heads-up at daily meeting)

2. Risk assessment. As it is important to quantify the risk level of the collected near-incidents for prioritizing countermeasures, the ISRS provide the convenient criteria for quantification of potential safety risks as described in Table 2 and Table 3.

3. Hearing investigation. The collected reports do not always contain enough information to extract lessons from the occurred near-incident. In such a case, hearing investigation is performed by the secretariat. A member of the secretariat visits a reporter and conducts the interview confidentially. After the completion of the hearing investigation, the collected report is de-indentified.

4. Countermeasures (Preliminarily Evaluation of Effectiveness). For realizing steady enhancement of safety, the effectiveness of countermeasures should be evaluated explicitly. ISRS provides a quick reference matrix for simplified evaluation of countermeasures as shown in table 4. For example, if a countermeasure removing the objective safety risk is taken, 7 points are subtracted from the risk score calculated based on table 2. Although the score given by the evaluation scheme provided here is just an approximated figure, it helps intuitive understanding of important facts concerning human factors such as “cautionary notices about the safety risk are hardly effective to prevent accidents”.

5. Feedback. The results of analysis of the collected reports have been fed back to company members in the form of a periodic report, a bulletin board, a letter ruling and so on. All the member of the company also can access safety information obtained from the safety reports through the near-incident database. In addition, a case list is quite important to spread safety information horizontally throughout the company. Our case list contains not only facts and direct causes of an occurred incident but also background factors, original risk level calculated by means shown in table 2 and 3, adopted countermeasures and remaining risk level. The additional information can support frontline workers to utilize the case list as a reference to prevent similar incidents by themselves.

Result

Company T has applied ISRS as a company's safety management system for two years. In the last two years, 1555 reports have been submitted and 155 cases have published as a case list. The case list has been utilized as an effective reference in the safety meeting of each work place every day. The detailed evaluation of ISRS is still underway, but the fact that ISRS has been positively accepted in Company T have strongly implied the effectiveness of ISRS

Conclusion

For the proactive safety management in conventional industrial field, the present study has proposed a safety reporting system called the Industrial Safety Reporting System (ISRS) based on ASRS. ISRS has been adapted for practical use in conventional industrial fields taking their features and constraints into consideration. Although the detailed evaluation of ISRS is still underway, the authors believe its effectiveness based on the achievements of ISRS as the safety reporting system of a construction company in the past two years. The further study to develop objective and quantitative safety measure is still going on to elaborate the proposed framework.

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