An Evaluation of Human Factors on Confirmation/Check Tasks in Organizational Safety Management

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ABSTRACT

In organizations' safety management, it is most important to ensure workers check their own work so that they can detect human error as early as possible. We study the checking task from the viewpoint of human factors with the aim of identifying factors impeding the performance of the checking task and proposing a method for mitigating the effects of such impeding factors. The checking task does not always play a good performance, making workers desirous of performance improvement. However, few attempts have been made to study the checking task beyond analyzing individual, concrete work contexts. We, first, identified and categorized problems regarding the checking task by statistically analyzing the result of the survey covering over 20,000 workers of 15 companies from several industries such as railway and general hospitals. The survey included distributing questionnaire and on-site interviews, both targeting site workers. We, next, got down on to further study the result of the above analysis as that we developed advice/tips data that can assist those who prepare a checklist. Based on the result of these analyses, we compiled a guideline on what to discuss and how to address it when adding new items to an existing checklist.

Keywords: Confirmation/Check Task, Human Factors

INTRODUCTION

Background

Today, Safety management in most industries in Japan is keeping a high standard, and they are considering measures for troubles and accidents from various angles. Thanks to their untiring efforts, the number of huge accidents such as the crash of a JAL MD11 aircraft in Japan which occurred in the late nineties is declining. The standard of Safety management is changing over the years, however, a slight incident far from serious accidents and troubles are handling as an object of Safety management. Therefore, many industries and organizations are facing with the challenging issue with work efficiency and confirmation/check tasks enhancement.Confirmation/check tasks play an important part before operators continue a following process, and regardless of skill which an operator possesses, you can finish a task completely with a last confirmation. Thus, confirmation/check tasks provide a work process management system that reliably confirms for errors and so, they can recovery and evade an accident and a trouble. Moreover, operations with checklists can avoid communication errors between an operator and his/her successor, omission errors and commission errors. That is why most organizations take it in every operation as the last process of it.I particularly put a focus on confirmation/check tasks in safety management, and considered and examined rearranging of the information of checklist, the process efficiency through the past study and the experiment of the

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human factor.

History

HEP(Human Error Probability) is positioned in a human error assessment based on the theory of probability and used over various areas. It is not an evaluation system having a quantitative evaluation index, but it is one having a qualitative evaluation index, so operators can develop their ability to consider logically for human error and improve their sensitivity and recognition for the risks on their own initiative.Then, this section presents an introduction of TESEO(Tecica Empirica Stima Errori Operatori) and HEART(Human Error Assessment and Reduction Technique).

Tecica Empirica Stima Errori Operatori

TESEO is a method to estimate a probability of human error. In 1980, Bello,G.c and Columbori V conducted it as a method to estimate errors made by operators in a power station based on experiential data. To lead the probability of human error, they defined identification of the error, quantification of the error and reduction of the error as main factors. And, based on these main elements, they evaluate the state of five following parameters and estimate the probability of human error of the whole operation by the product of five evaluation level.

K1: Type of Activity
K2: Temporary Stress Factor for Routine Activities
K2: Temporary Stress Factor for Non-Routine Activities
K3: Operator Qualities
K4: Activity Anxiety Factor
K5: Activity Ergonomic Factor

TABLE 1.1: TESEO Parameters

Type of Activity	K1
Simple, routine	0.001
Requiring attention	0.010
Not routine	0.100

TABLE 1.2 TESEO Parameters

Time available Factor for routine activity	K2
2 sec	10
10 sec	1
20 sec	0.5

TABLE 1.3: TESEO Parameters

Time available Factor for non-routine activity	K2
3 sec	10
30 sec	1
45 sec	0.3
60 sec	0.5

TABLE 1.4: TESEO Parameters

Operator's typological factor	K3
Carefully selected expert, well trained	0.5
Average Knowledge	1
Little knowledge	3

TABLE 1.5: TESEO Parameters

Activity anxiety factor	K4
Situation of grave emergency	3
Situation of potential emergency	2
Normal situation	1

TABLE 1.6: TESEO Parameters

Activity ergonomic factor	K5
Excellent microclimate and excellent interface	0.7
Good microclimate and good interface	1
Discreet microclimate and discrete interface	3
Discreet microclimate and poor interface	7

Poor microclimate and poor interface	10

$$(\text{Probablity of error}) = K1 \cdot K2 \cdot K3 \cdot K4 \cdot K5$$

Human Error Assessment and Reduction Technique

HEART is a method developed by J.C.Williams working at central power center in the UK. And it is consisted of 5 steps to estimate the probability of error.

1. Select Generic Task
2. Select candidate: Error Producing Conditions (EPCs)
3. Check for GT with EPC
4. Calculate PoA for each EPC

$$EPC' = ((EPC - 1) \times PoA) + 1$$

5. Multiply GT by adjusted EPCs

$$p(E) = GT \prod EPC'i_{i=1}^{m}$$

INVESTIVATION AND ANALYSIS

Evaluate the Level of Human Error Management

By evaluating the level of the safety management, we could know the workers' motivation for confirmation/check tasks and find potential problems through it. For 7 steel companies, 5 railway companies, 7 general hospitals and 2 oil refining companies, we made survey of the workers' understanding level about safety activities/management and confirmation/check tasks for all employees. A content of the survey is 20 questions (Fundamental Principle) to evaluate depth of understanding about safety management and 10 questions (Confirmation/Check System) to evaluate a system confirmation/check tasks. How to answer to these question is select a number (1~4); Disagree(1), Partly agree(2), Agree(3), Strongly agree(4).

TABLE 2.1: Survey

Fundamental Principle	1	You never make a mistake.
	2	Low skill leads errors and mistakes.
	3	You want to hide your mistake.
	4	A fault of a mistake is whose make the mistake.
	5	Careless/absent minded mistakes are responsibility of a person.
	6	Making efforts enables to reduce human error.
	7	Making person never mistakes enables to reduce human error.
	8	You have no luck when you make a mistake.
	9	It is troublesome to write human error and a trouble report, and I write only necessary minimum.
	10	You do not understand the reason why you have to write about an incident.
	11	You have no opportunities to learn about safety management.
	12	You have never received a lecture about human error research.
	13	An investigation of human error is time-wasting for you.
	14	You do not know a purpose of analysis of human error.
	15	You never analyze a cause of human error.
	16	Only prevention of recurrence of error is enough.
	17	Human error prevention activities performed now are enough.
	18	You are not interested in other companies' safety management.
	19	Human error prevention activities should be considered and coped individually.
	20	There is no necessity of managing human error as an organization etc. (Or it is hard-pressed)
Confirmation/Check Systerm	21	Actual work of Confirmation/check tasks is just "writing checks".
	22	Items of checklist have no priority.
	23	Capacity of Confirmation/check tasks is irrelevant and not administrated.
	24	The contents of checklist are periodically maintained.
	25	A checker is not familiar with the characteristics of operations and operators.
	26	There is little communication between a checker and workers (operators).
	27	There is no difference between check-mistakes and human errors.
	28	There is no feedback of errors and mistakes occurred.
	29	A training period is not enough to use appropriately a checklist.
	30	There is a difference between checkers.

THE RESULT OF THE SURVEY

A totaling the results of the survey is below.

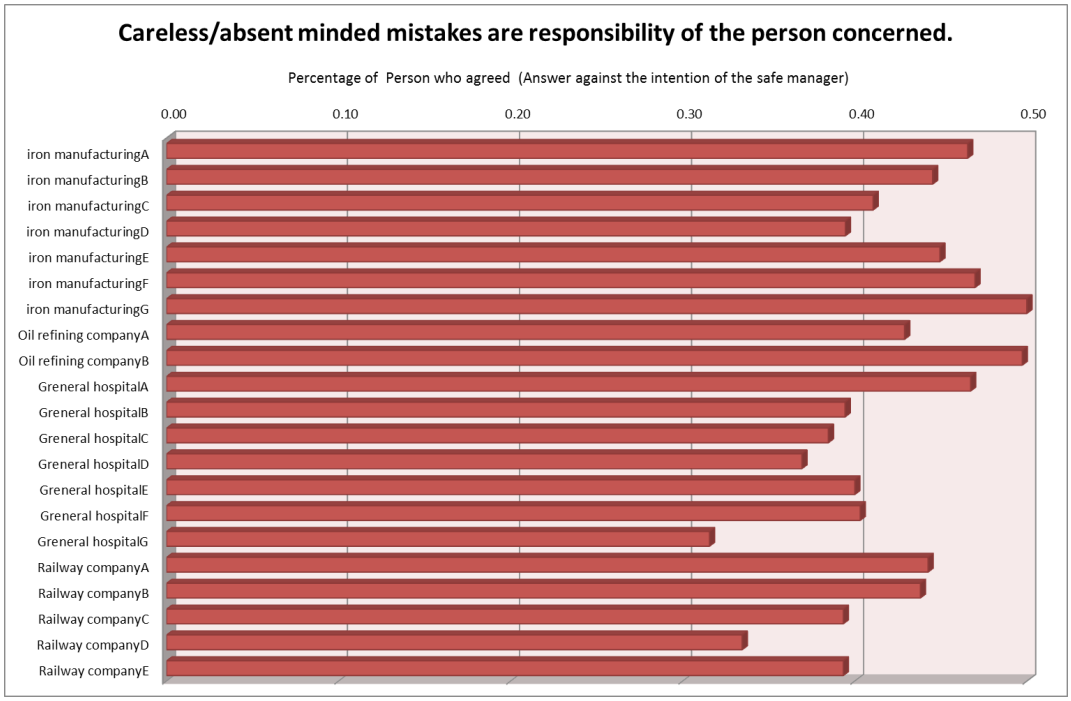

FIGURE 2.1: Q5

You can see from Figure 2.1, most workers think that “a person who committed an error should responsible for it”, so errors are inclined to be dealt as individual problem and be thought none of concerns with other persons by them. Moreover, as safety management actively advances, lectures/instructions on human errors tend to increase, and so dissatisfaction “I am enforced the new countermeasure because of somebody made a mistake.” is increasing as well. Eventually, if a safety manager considers that human error belongs to the person concerned, he tends to make a new countermeasure to prevent it by reinforcing confirmation/check tasks. Then confirmation/check tasks are continuously gradually adding in volume. Too much capacity and too often alteration of countermeasures are hardly pressing workers, and in the result they are worn out from stress and have negative image for safety management.

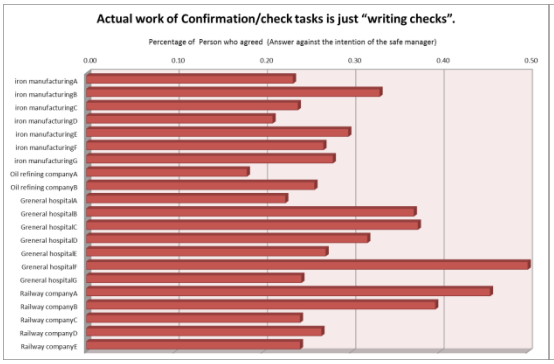

FIGURE 2.2: Q21

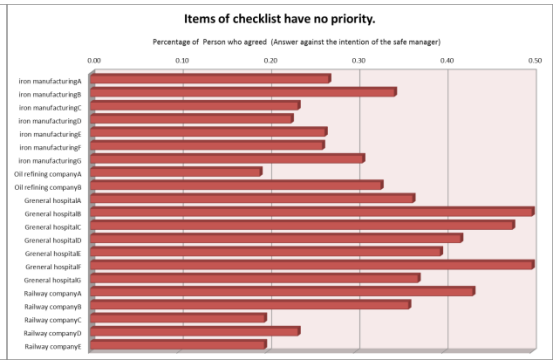

FIGURE 2.3: Q22

The result showing by Figure 2.2 and figure 2.3 explains that most companies have a confirmation/check system that makes workers bored and soul-destroying.

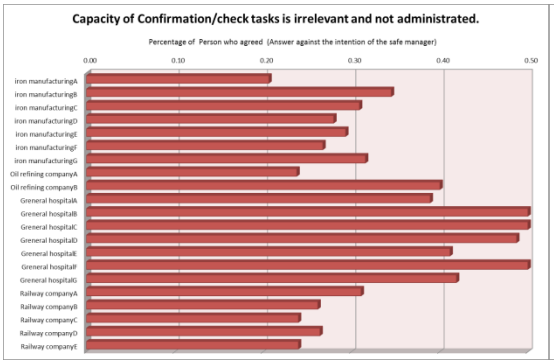

FIGURE 2.4: Q23

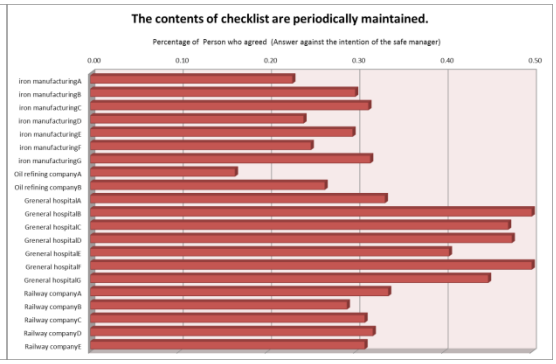

FIGURE 2.5: Q24

According to Figure 2.4 and Figure 2.5, when it comes to confirmation tasks, there is no regular/routine maintenance and safety managers do not take capacity of site-workers into consideration. Then, an inappropriate quantity of confirmation/check tasks is left that as is all along. At least 20%, at most 60% of workers answered in the affirmative.

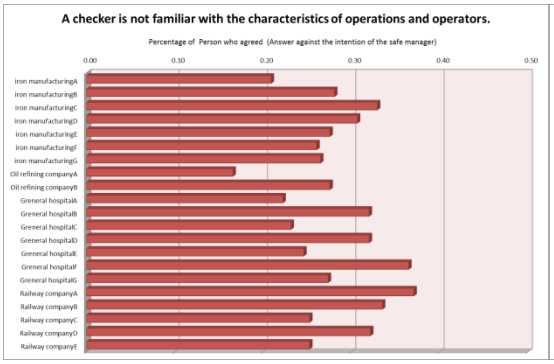

FIGURE 2.6: Q25

FIGURE 2.7: Q26

Figure 2.6 and 2.7 explain that some workers who do not have enough skill play confirmation/check tasks. That is because training period is not enough long for workers and a safety manager who made checklists is not able to understand each workers' situations. Insufficient skill leads commission errors.

INTERVIEWS WITH COMPANIES

Railway Companies

- The number of confirmation/check tasks with checklist is increasing in these years due to troubles and accidents. That is because most departments easily put in force new countermeasures with checklists.
- Even though improvement plan of checklist are carried out, a similar accident and trouble could often happen. They felt limit on effects of checklist.
- Instead of increase of the number of items/types on checklist, it is necessary to change it understandable and easier to use.
- A problem of use of checklist is that workers are inclined to become mannerism.
- Double check does not completely perform. A second checker depends on the first checker too much.
- Young employees have never experienced serious troubles and accidents, so they are so ashamed of their own failure and mistake that they often hide it. Thus, a delay of their report of mistakes led a situation to grow more serious.
- There are a lot of types of checklist. It makes difficult to improve an existing checklist.

General Hospitals

- There are many checklists to confirm a status before taking over.
- Because the number of checklists is getting more and more, employee have no time to spare to carefully check each items of checklist.
- A director of nursing service department notice that nurses are suffered from stupendous capacity of

checklist, but he/she is resistant to any change of checklist because of a threat of accident.

- It is good for employee to responsible for what they have done with checklist because confirmation/check tasks enable to make clear who have done the operation. And then, they would perform with a high level of awareness.

SUGESSION

Countermeasure Guidance System

We compiled keywords to guide countermeasures which were made by not only safety manager but also site-workers in case of consideration of measures to prevent recurrence.

TABLE 4.1: Countermeasure Guidance Keywords

A	Use inappropriate tool/mistake procedure/miss process
B	In a condition of being weakened not to correctly judge
C	Perform without imaging of the result of the performance
D	Perform with little regard to the risk of performance
E	Perform without standards for judgment/unreadable figure
F	Insufficient preparation for information/tool
G	Operation in an invisible manner
H	Difficult task with current system

Writing report with countermeasure guidance keywords makes easier that safety managers and employees can make up with countermeasures except for reinforcing confirmation/check tasks.

Guideline

This guideline is composed in a case assumed, where employee want to make up with countermeasures to improve checklist based on human, reliability knowledge except to reinforce confirmation/check tasks. Therefore, the guideline has information on supplementation of past accidents and troubles. There two types of guideline.

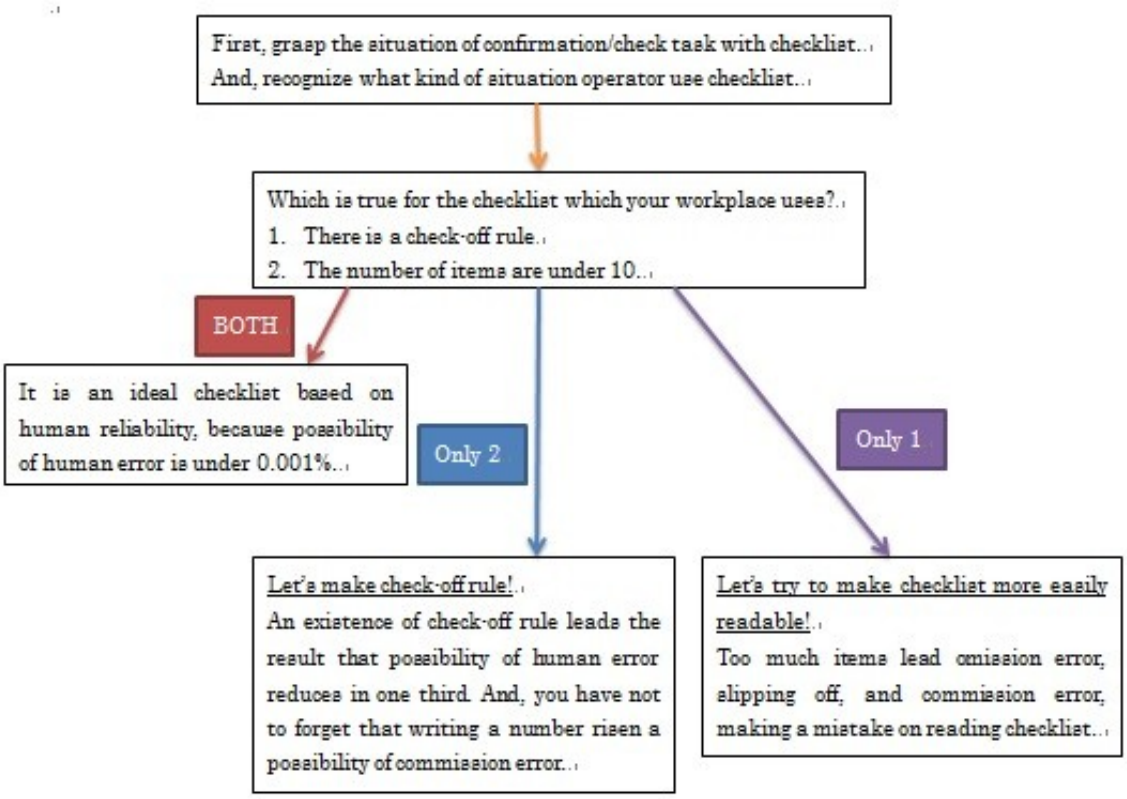

FIGURE 4.1: Guideline1- A Case Where Employee Have Enough Time To Set Up New Countermeasures

FIGURE 4.2: Guideline2- A Case Where Employee Is Unable to Plan Countermeasure Except for Checklist Because of Lack of Time

CONCLUSIONS

In this study, we are focusing on confirmation/check tasks with checklist and analyzing factors that inhibit performance from different points of view, in the result, we could clarify them. Moreover, the compiled guideline has been presented to the surveyed companies and now put into practical use on a trial basis, assisting those who prepare checklists.

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