



A Study on Human Error Recovery Effect by Strengthening Follow-up System among Workers in Team Work



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The Aim of this Study

Railway companies aim to improve enterprise value by providing railway services to ensure users safety and peace of mind. Thus, in safety activities, the purpose is derived not only from accident prevention activities but also for lifting up motivation of employees. Among such safety activities, there is "the strategy of establishing the follow-up system" that some companies promote. This strategy is to establish and strengthen a follow-up system, which is an organizational system with a posture to prevent small errors and carry out tasks smoothly by helping each other as a team. This paper provides an analysis method for the progress of retention rate of the follow-up system and change in consciousness to safety activities to clarify a group with behavior posture of voluntary follow. Moreover, this paper aims to create an advice list for actual work in 10 categories on the basis of these results.

The Flow of Creating Advice List

First, we extracted six items of follow-up behavior index ("Goal achievement", "Group maintenance", "Positive", "Critical", "Consideration", "Interpersonal assistance") by referring to action indicators in four fields ("Followership", "Leadership", "Organization citizen behavior", "CRM skills") and comparing them with actions that can be realized in the actual site.

Then, we developed an analytical method to evaluate the progress of it by preparing evaluation algorithm of five grades for each of the six indicators and evaluating the remarks in the discussion which is part of the safety activities in the actual enterprises.

Then, based on the basic model that the progress of it influences the change in the consciousness to safety activities of employees, we developed an analytical method to verify the change of companies whose follow-up system has been established.

Then, consciousness to safety activities is divided into four groups "collective cohesiveness" "aggressiveness" "check system" "trouble countermeasure". In addition, we executed multilevel analysis, hierarchical linear modeling and a simple effects analysis to the data of the survey of the consciousness. Finally, based on the two analytical methods, we created a group classification table of 10 categories and an advice list aiming at utilization of check lists in each category.

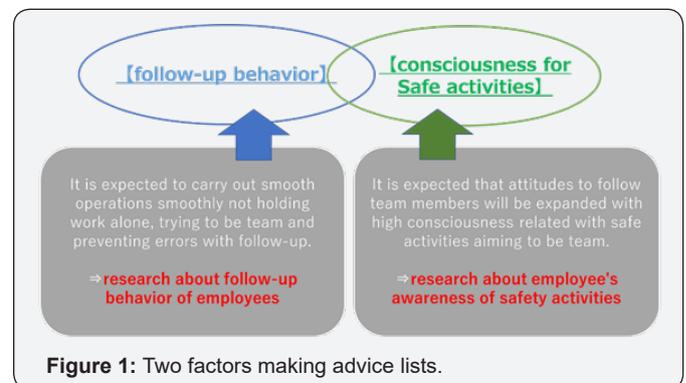


Figure 1: Two factors making advice lists.

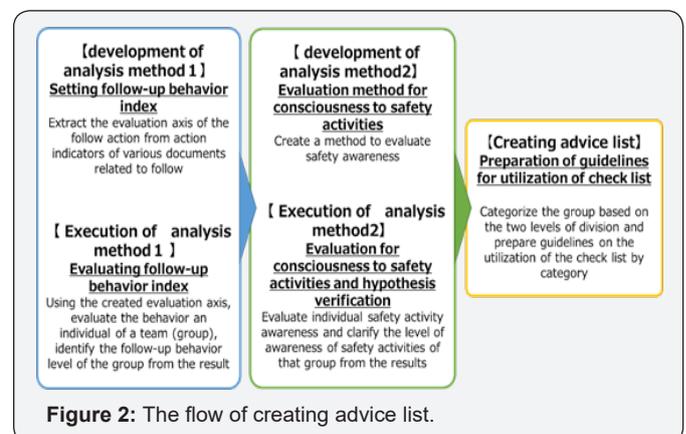


Figure 2: The flow of creating advice list.

In conclusion, the analysis method and advice list prepared in this study indicated the possibility of clarification a group with behavior posture of voluntary follow. Identify employee's awareness of safety activities (Figure 1 & 2).

Setting follow-up behavior index

I set six behavior index, "Goal achievement", "Group maintenance", "Positive", "Critical", "Consideration", "Interpersonal assistance". It is desirable that these action indicators are kept in good balance. We can see the action attitude from three perspectives.

First, focusing to "Goal achievement" and "Group maintenance", these show the view point that emphasizes in carrying out tasks. We can grasp whether the organization or the employee is a behavioral attitude to prioritize work, a behavioral attitude to prioritize human relations, or a behavioral posture to think both in balanced way.

Second, focusing to "Positive" and "Critical", these show the attitude towards work and group. Comparing to two index, It is possible to grasp the behavior attitude whether the organization or the employee active or critical to group and try to get better group status.

Finally, focusing to "Consideration" and "Interpersonal assistance", these show the attitude towards interpersonal. If "Consideration" is high, the employee have consideration to others. And if "Interpersonal assistance" is high, they try to assist and help others (Figure 3).

follow-up behavior index	Action
Goal achievement	Behavioral attitude towards work that is self-reliant, emphasizes work efficiency
Group maintenance	Behavioral attitude toward human relations considering of being a group
Positive	Active attitude towards work and human relations
Critical	Attitude to criticize the current situation from the positive attitude of changing the present situation
Consideration	Conscious behavioral attitude towards work and human relations
Interpersonal assistance	Attitude to try to assist interpersonal even if you make your work secondary

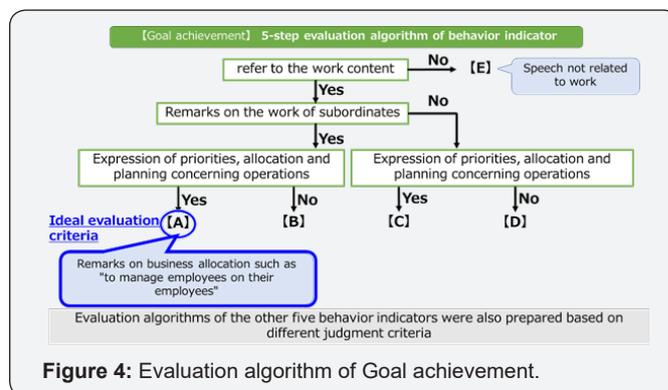
Figure 3: Follow-up behavior index and Action.

Evaluating follow-up behavior index

We prepare algorithm for evaluating six behavior indicators and classify into five stages A to E. Figure 4 introduce about "Goal achievement". We classified employees who evaluated by the algorithm into three groups of low behavioral awareness people, middle behavior conscious people, high behavioral conscious people. In the railroad company, it is aimed to raise low behavior conscious people, so in this study, we focused on low behavior conscious people and medium behavior conscious people.

Then, based on the ratio of low behavior conscious and medium behavior conscious, the follow - up behavior is classified

in order to prepare advice list for judging whether or not the checklist can be used effectively in a workplace environment (Figure 4 & 5).



Level	Each follow-up behavior indicator		
	conditions	low behavior conscious employee	midium behavior conscious employee
i	1 or more	over 50%	-
ii	4 or more	over 30% less than 50%	-
iii	4 or more	over 10% less than 30%	-
iv	4 or more	over 1% less than 10%	less than 50%
v	4 or more	less than 1%	less than 40%
vi	5 or more	less than 1%	less than 20%
vii	6 or more	less than 1%	less than 10%

Figure 5: Level classification of behavior conscious employee

Evaluation method for consciousness to safety activities

We implement search system using for consciousness to safety activities (HEMAS: Human Error Management Assessment System in railroad company X.) HEMAS evaluate employee's consciousness in score of 1 to 5 points.

We executed multilevel analysis setting that response variable is "trouble countermeasure" and explanatory variables are "collective cohesiveness" "aggressiveness" "check system" "position".

Evaluation for consciousness to safety activities and hypothesis verification

As a result of multilevel analysis, employee's "collective cohesiveness" "aggressiveness" "position", especially "check system" influence "trouble countermeasure".

Thus, the rising of employee's consciousness for trouble countermeasure lead to making work environment which can checklists effectively.

$$y=0.861+0.230x_1+0.115x_2+0.113x_3+0.540x_4$$

y:Individual level troubleshooting awareness score

x₁:Individual position (0 ...7: larger as the position is higher)

x_2 : Collective cohesiveness score of individual level
 x_3 : aggressiveness score of individual level
 x_4 : Consciousness score for check system of individual level

model	step.1				step.2					
	1-1		1-2		1-3		1-4		1-5	
	β	p								
Intercept	3.33 ***		1.84 ***		2.42 ***		1.45 ***		0.861 ***	
position	0.0225 **								0.230 ***	
collective cohesiveness			0.442 ***						0.115 ***	
aggressiveness					0.216 ***				0.113 ***	
check system							0.571 ***		0.540 ***	
R ²	0.00318		0.0896		0.0591		0.401		0.437	
R ² *	0.00285		0.0893		0.0587		0.401		0.436	
F	9.679 **		298.5 ***		190.4 ***		2032 ***		587.7 ***	
AIC	5799.26		5524.04		5624.14		4252.33		4071.98	

***:p<0.001, **:p<0.01, *:p<0.05, +:p<0.1

Figure 6: A result of multilevel analysis.

(Figure 6) Based on the scores of HEMAS, we classified them as low conscious and high conscious. In preparing guidelines for judging whether workplace environments that can utilize checklists are available or not, we divided the level of awareness of safety activities into five stages (Figure 7 & 8).

Creating advice lists

	score level	detail
low conscious	less than 3 score	Low awareness and comprehension of safety activities
high conscious	over 3 score	Awareness of safety activities is high, spontaneous behavior can be expected

Figure 7: The level of awareness of safety activities

Level	Percentage of safety consciousness awareness
	low conscious
1	over 30%
2	over 20% less than 30%
3	over 10% less than 20%
4	over 50 less than 10%
5	less than 5%

Figure 8: Classification of 5 level.

category	Level	conditions	Each follow-up behavior indicator		Level	Percentage of safety consciousness awareness
			low behavior conscious employee	midium behavior conscious employee		low conscious
A	i	1 or more	over 50%	-	1	over 30%
B	ii	4 or more	over 30% less than 50%	-	1	over 30%
C	iii	4 or more	over 10% less than 30%	-	1	over 30%
D	iv	4 or more	over 1% less than 10%	less than 50%	1	over 30%
E	iv	4 or more	over 1% less than 10%	less than 50%	2	over 20% less than 30%
F	iv	4 or more	over 1% less than 10%	less than 50%	3	over 10% less than 20%
G	iv	4 or more	over 1% less than 10%	less than 50%	4	over 50 less than 10%
H	v	4 or more	less than 1%	less than 40%	4	over 50 less than 10%
I	vi	5 or more	less than 1%	less than 20%	4	over 50 less than 10%
J	vii	6 or more	less than 1%	less than 10%	5	less than 5%

Figure 9: Each level correspondence table in category.

Each level correspondence table in category

	D	E	F	I	J
vii	D	E	F	I	I
vi	D	E	F	H	H
v	D	E	F	G	G
iv	D	E	F	G	G
iii	C	C	C	C	C
ii	B	B	B	B	B
i	A	A	A	A	A
	1	2	3	4	5

Advice lists

category	Advice lists
A	自分のチェックリストを用いて、対策において項目が増えることも認容する。チェック・確認動作に頼り、項目の作業内容を厳密に、正確に行うよう努める。
B	自分のチェックリストを用いて、対策において項目が増えることも認容する。チェック・確認動作に頼り、項目の作業内容を厳密に、正確に行うよう努める。
C	自分のチェックリストを用いて、対策において項目が増えることも認容する。チェック・確認動作に頼り、項目の作業内容を厳密に、正確に行うよう努める。
D	自分のチェックリストを用いて、対策において項目が増えることも認容する。チェック・確認動作に頼り、項目の作業内容を厳密に、正確に行うよう努める。
E	自分のチェックリストに3段階程度の優先度をあてはめ、最低の優先度の項目について確認して、ただし、1か月経過したら検討し直す。
F	自分のチェックリストに3段階程度の優先度をあてはめ、最低の優先度の項目について確認して、ただし、1か月経過したら検討し直す。
G	自分のチェックリストに3段階程度の優先度をあてはめ、最低の優先度の項目について確認して、ただし、1か月経過したら検討し直す。
H	自分のチェックリストに3段階程度の優先度をあてはめ、最低の優先度の項目について確認して、ただし、1か月経過したら検討し直す。
I	自分のチェックリストに3段階程度の優先度をあてはめ、最低の優先度の項目について確認して、ただし、1か月経過したら検討し直す。
J	自分のチェックリストに3段階程度の優先度をあてはめ、最低の優先度の項目について確認して、ただし、1か月経過したら検討し直す。

Figure 10: Advice lists.

The table 9 of follow-up behavior level connect the table of consciousness to safety activities. Advice lists about the use of checklists in each category are below (Figure 9 & 10).

Classification in Railroad Company

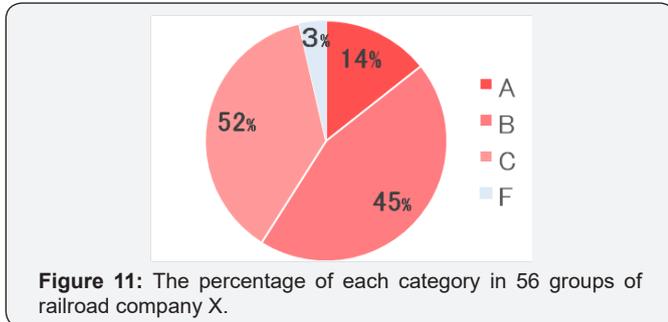


Figure 11: The percentage of each category in 56 groups of railroad company X.

The percentage of each category in 56 groups of railroad company X is showed in Figure 11. From the results, although the distribution varied, most of the groups are belonging to

categories B and C. Considering that the beginning of the follow-up strategy was category A, we can see the work environment is getting better, but it is still in the process of development. Judging the maturity of the group of A to C, based on the advice list, it turned out that “it is a group that should endeavor to accurately perform the work content of the item using the existing checklist”. Thus, it is found that the maturity level as a work environment where follow-up actions can be taken is still low, and it is at the stage where it should go using the checklist.

And, it is turned out that it is possible to create an atmosphere to follow each other such as positively honoring voice at operation department of driving section, which is one of the groups belonging to the highest level category F. Therefore, advice list can show accurate state of group.

We can showed the level of group which can use check lists effectively making advice list. In a current situation, it was also found that the check lists are more effective than the reduction of the work load at railroad company X.



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