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Effects of Communication Company's Safety Management System on Workers' Safety Consciousness and Safety Observance Behavior

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Abstract

In this study, the effect of a telecommunication company's safety management system on workers' safety awareness and safety behavior was empirically verified. The main findings are as follows: First, among the factors of the telecommunication company's safety management system, the management supervisor's capability and level of industrial accident investigations were found to have a significant positive effect on workers' safety awareness. Second, workers' safety awareness was observed to exert a significant positive effect on their safety behavior. Third, among the factors of the telecommunication company's safety management system, the management supervisor's capability and industrial accident investigations were found to have a significant positive effect on the safety behavior of workers. Fourth, although the telecommunications safety management system factors, such as management supervisors' capability and industrial accident investigations, were found to have a positive effect on workers' safety awareness, they had no mediated effect on workers' safety behavior through safety awareness.

Index Terms: Communication companies, Safety management system, Health care program, Safety culture

I. INTRODUCTION

A. Background and Purpose of Research

Accidents at telecommunications work sites represent a larger and more serious form of disaster than those in other industries, such as general service, transportation, distribution, and manufacturing. A well-equipped corporate environment that prioritizes safety over work schedules facilitates work efficiency without mishaps [1, 2]. In the telecommunications workplace, workers must recognize the importance of safety and translate it into action to achieve good construction results [3]. Safety awareness is the knowledge of everything that must be observed to maintain safe construction practices in the workplace. It also refers to the will or condition to act with this knowledge. Prior studies analyzing the value that the workers place on safety have shown that their sense of safety represents the relationship between their safety behavior and the relationship between accidents and wealth [4, 5]. According to these studies, an organization's negative safety climate suggests that the workers ignore safety procedures, act carelessly, and eventually increase the risk of accidents.

However, measures are still lacking to identify the causes of industrial accidents, such as frequent injuries and deaths of workers at the work sites of telecommunication companies. Preventing recurrence and, hence, the repetition of a vicious cycle of only managing the aftereffects of the acci-

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dent with possibility of the same accident occurring again in future should be undertaken. Studies related to telecommunication accidents have been conducted only on the current or actual status of accidents, with most of them only suggesting measures. However, research on the derivation of safety management system factors as well as an empirical verification of the factors—a positive impact on workers' awareness of safety and actual safety-related behavior in such a safety management system—is very limited. Therefore, empirically analyzing how the safety management systems telecommunication companies affect the workers' safety awareness and safety behavior is very important.

This study aims to identify safety management systems, safety awareness, and safety behavior among the workers of telecommunication companies, as well as the correlation between the safety management system and the safety awareness and behavior of the workers. Further, we intend to identify the safety management factors that can prevent safety accidents at the telecommunication work sites and suggest measures to improve worker safety awareness. The specific purpose of this research is as follows. First, we verify the impact of the telecommunication safety management systems on the safety awareness of workers. Second, we verify the effect of this awareness on their safety behavior. Third, we verify the effect of the telecommunications safety management system on the safety behavior of workers.

II. THEORETICAL BACKGROUND

A. Safety Management

Safety management is a concept used in industrial sites, such as those of telecommunication companies, and comprises the entire corporate process of planning, implementation, control, and coordination to reduce work-related disasters [6]. In particular, safety management in telecommunication business sites is a systematic activity that protects lives and assets by preventing disasters caused by inefficient factors (human or otherwise).

A telecommunication safety management system can be divided into four factors: management of supervisor competency, in-house safety management activities, safety education, and disaster evaluation [7]. The supervisory factor that requires safety management and monitoring includes the ability to recognize the safety risks in the workplace, monitor the workers' understanding of the safety management system, communicating with them, and providing feedback on the results. The in-house safety management factor involves allowing the workers to identify and report suspected industrial accidents in the company, periodically checking the system, and tracking the process from problem discovery to solution. Safety education refers to conducting regular education and training, emphasizing the proper arrangement of work tools and equipment, and imparting education on safety rules and compliance. Finally, disaster assessment includes performing objective surveys according to reasonable standards during a disaster investigation, taking prompt measures to prevent the recurrence of construction disasters, and the evaluation of punitive procedures after a disaster investigation.

Kim [8] stated that safety management at a construction site should prevent disasters at the workplace. It should be conducted for all processes, from the occurrence of disasters to the follow-up process, including safety, education, and the health of workers. Disaster prevention measures at the construction site are aimed at reducing risks in the workplace environment and unsafe worker practices; however, for ensuring continuous safety, safety awareness and leadership are the most important factors. The Occupational Safety and Health Act obliges operators to appoint safety managers and conduct safety and health committee meetings dedicated to technical content and appointment of management supervisors [7].

B. Safety Consciousness

Safety consciousness refers to an active awareness and response to protect oneself from danger [8]. It is also the ability and attitude to recognize the risk factors and effectively cope with the situation [9]. Safety consciousness is the most basic human instinct.

A few previous studies have shown that consciousness leads to action [10]. On the contrary, others argue that consciousness does not necessarily lead to actual behavior [11]. The general definition of safety is an active concept, meaning that there is no danger to the surrounding environment. The broad meaning of safety is that the right to survive, whether direct or indirect, is not threatened, and specifically, there is protection from industrial damage or disaster. Workers' safety is a condition that ensures very little risk. As a company, it means that there is no risk of disaster; therefore, there is no damage to people and goods.

The basic principle of safety is the pursuit of an accident-free environment. However, in reality, institutional and human unsafe factors and actions directly contribute to a variety of situations, leading to the occurrence of accidents; therefore, if we find and eliminate these sources of instability, we can prevent them as much as possible [12]. Thus, awareness of safety is paramount [13].

Telecommunication companies' construction sites mostly employ subcontracted workers who have a relatively low sense of belonging to these companies and organizations and lack opportunities for safety education. In addition, because of the special nature of the work, working hours are flexible, and there are several days without holidays owing to air deadlines, potentially leading to fatigue-induced careless-

ness. In large-scale constructions, there is a lack of safety considerations and safety management capabilities for workers owing to reduced service construction costs and shorter construction periods [6].

C. Safety Observance Behavior

Safety at industrial sites refers to a state where there is no risk of accidents or disasters. In particular, it is related to the work process at the workplace, and the behavior of workers to protect their safety is called safety observance behavior [14]. Bird [15] argued that human and asset disasters are a fundamental problem for the management systems of companies and organizations, and there are prior direct causes that always lead to disasters. This means that the cause of an accident can be identified to a certain extent, and Bird recognized that unsafe behavior and working conditions directly lead to accidents. For example, if an accident occurs while working without a safety helmet, the direct cause is wearing a safety helmet; however, with the worker's low awareness of safety rules, the basic cause of the accident was attributed to poor safety education and safety management system.

Workplace accidents are frequent and mostly caused by unintended mistakes, which in turn increase the possibility of accidents caused by a lack of a safety management system. If a worker does not comply with the safety rules or a fellow worker does not engage in activities to protect and maintain safety, there is an accident, and if there are many such workers, the risk of an accident increases proportionately. Therefore, safety management should be applied systematically to reduce the correlation between the workers' safety behavior and on-site safety accidents to a negative value. Neal and Griffin [5] also stated that corporate safety culture is closely related to safety behavior and can prevent or reduce accidents, and placing a value on safety affects the on-site atmosphere and behavior. Safety values and mood represent the desire for safety actions, which in turn leads to their implementation [16].

Earlier findings show that the possibility of an accident can be identified in advance through the atmosphere of the work site, and the higher the safety awareness of the workers, the fewer the causes of accidents or disasters. The safety behavior in an organization can be said to have a significant impact on its safety culture and safety management system, and the safety values of individual workers.

III. RESEARCH DESIGN

A. Survey Subjects and Survey

For this study, 205 questionnaires were distributed to a sample group of workers at the work sites of a telecommunication company, and 196 valid survey responses were used for final statistical analysis, except those that omitted answers to a few questions. Sufficient explanation was provided and consent for the study was obtained from the workers who agreed to participate, and the respondents were asked to complete the survey by self-legislation. An overview of the survey is shown in Table 1.

Table 1. Outlines of the investigation.

Investigation period	From the first week of January 2021 to the fourth week of January 2021 (4 weeks)
Population	Workers at national telecommunications construction sites
Sample group	205 workers (A communication company) - 71 supervisors, 104 field workers, and 30 safety managers
Analysis	Out of 300 copies, 196 were valid questionnaires
Investigation method	Self-written method (Field distribution)

B. Research Hypotheses

Safety culture is a very positive factor for a company's safety performance, and the higher the safety awareness of workers at construction sites, the lower the disaster rate. Several studies have shown that workers' awareness of safety in the workplace has a static correlation with their safety behavior. In contrast, the safety consciousness of a worker correlates negatively with accidents, which is an inverse relationship to that of safety behavior [4, 5]. An organization's negative safety culture means that safety awareness, such as not following systematic safety procedures, causes careless behavior and, thus, increases the likelihood of accidents. Neal and Griffin (2006) [5] recognized safety awareness as a prerequisite for safety behavior and empirically presented the correlation between the perception of safety and the level of safety behavior. Based on the above-discussed research and model, the following hypotheses were derived:

C. Research Measurement Tool

The telecommunications safety management system was measured through four indices: management supervisor's ability, in-house reporting culture, safety education, and industrial accident investigation. In this study, the safety awareness and safety behavior of the telecommunications workers were measured as single factors, and the questionnaire was based on the researches of Lee [7], Kim [17], and Kim [18].

D. Research Analysis Method

The survey data collected for this study were statistically

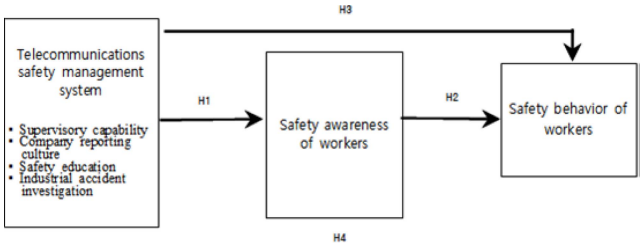

Fig. 1. Research model.

H1. The telecommunications management supervisor competency factor will affect the safety awareness of the worker by positive correlation.
H2. The safety awareness of telecommunications workers will affect positive correlation's safety behavior.
H3. The telecommunications management supervisor competency factor will affect the safety behavior of the worker by positive correlation.
H4. The safety management system of the telecommunications corporation will affect the safety awareness of workers by positive correlation.

processed using SPSS 26.0 and AMOS 26.0. First, the frequency and percentage were calculated to identify the general characteristics of the surveyed subjects. Second, the confirmatory factor analysis (CFA) performance and Kronbache's α coefficient were assessed to verify the feasibility of the carrier's safety management system, worker safety awareness, and safety behavior variables. Third, a structural equation model (SEM) analysis was conducted to verify the impact of the telecommunication safety management system on workers' safety awareness and safety behavior, and the impact of safety awareness on safety behavior. The mediating effect of safety awareness on the relationship between the carrier safety management system and worker safety behavior was verified through the bootstrapping method. The level of caution (α) for all statistical analyses and hypothesis verification was set at .05.

IV. POSITIVE ANALYSIS RESULTS

A. Demographic Characteristics of the Survey Subjects

The general characteristics of the carrier safety manager (who is under investigation in this study), supervisor, and general workers are shown in Table 2. A total of 71 supervisors were over 96 workers. According to employment type, 171 (87.2%) were full-time employees, 17 (8.7%) were non-regular workers, and 8 (4.1%) were daily workers. According to age distribution, 23 (11.7%) workers were in their 20s,

Table 2. Demographic characteristics of survey subjects.

	Categories	Safety manager		Supervisor		Workers		Totality	
		N	(%)	N	(%)	N	(%)	N	(%)
Employment type	Full-time	26	(89.7)	71	(100.0)	74	(77.1)	171	(87.2)
	Non-regular workers	3	(10.3)	0	(0.0)	14	(14.6)	17	(8.7)
	Daily work	0	(0.0)	0	(0.0)	8	(8.3)	8	(4.1)
Age	Twenty	6	(20.7)	6	(8.5)	11	(11.5)	23	(11.7)
	Thirty	6	(20.7)	25	(35.2)	25	(26.0)	56	(28.6)
	Forty	13	(44.8)	35	(49.3)	37	(38.5)	85	(43.4)
	Over 50s	4	(13.8)	5	(7.0)	23	(24.0)	32	(16.3)
Safety accident Experience or not	Experience	11	(37.9)	20	(28.2)	20	(20.8)	51	(26.0)
	No experience	18	(62.1)	51	(71.8)	76	(79.2)	145	(74.0)
Academic background	High school dropout	0	(0.0)	0	(0.0)	3	(3.1)	3	(1.5)
	High school graduate	11	(37.9)	18	(25.4)	47	(49.0)	76	(38.8)
	Junior college graduate	8	(27.6)	27	(38.0)	30	(31.3)	65	(33.2)
	University graduate	9	(31.0)	26	(36.6)	16	(16.7)	51	(26.0)
	Above Graduate school	1	(3.4)	0	(0.0)	0	(0.0)	1	(0.5)
Working years	Less than six months	1	(3.4)	1	(1.4)	2	(2.1)	4	(2.0)
	More than 6 months ~ less than 1 year	0	(0.0)	7	(9.9)	8	(8.3)	15	(7.7)
	More than 1~ less than 3 years	7	(24.1)	8	(11.3)	21	(21.9)	36	(18.4)
	More than 3~ less than 5 years	5	(17.2)	10	(14.1)	16	(16.7)	31	(15.8)
	More than five years	16	(55.2)	45	(63.4)	49	(51.0)	110	(56.1)
One day working hours	Within 8 hours	9	(31.0)	25	(35.2)	50	(52.1)	84	(42.9)
	Within 10 hours	19	(65.5)	39	(54.9)	40	(41.7)	98	(50.0)
	Within 12 hours	1	(3.4)	4	(5.6)	4	(4.2)	9	(4.6)
	Etc.	0	(0.0)	3	(4.2)	2	(2.1)	5	(2.6)
	Sum	29	(100.0)	71	(100.0)	96	(100.0)	196	(100.0)

56 (28.6%) in their 30s, 85 (43.4%) in their 40s, and 32 (16.3%) in their 50s or older. Of all the workers, 51 (26.0%) had experienced safety accidents while working at telecommunications companies, whereas 145 people (74.0%) had not, indicating that approximately three-quarters of those surveyed had no experience in safety accidents while on duty. In terms of academic background, 3 (1.5%) workers were high school dropouts, 76 (38.8%) high school graduates, 65 (33.2%) college graduates, 51 (26.0%) were four-year course university graduates, and 1 graduate school student (0.5%). On the other hand, 4 (2.0%) people had worked less than 6 months, 15 (7.7%) more than 6 months to less than 1 year, 36 (18.4%) for 1–3 years, 31 (15.8%) for 3–5 years, and 110 (56.1%) over 5 years. Lastly, 84 (42.9%) employees worked 8 h per day, 98 (50.0%) 10 h per day, and 9 (4.6%) 12 h per day. As the number of others was 5 (2.6%), more than half of the workers (57.1%) worked more than 8 h a day.

B. Validity and Reliability Verification of Measurement Tools

To verify the intensive feasibility and validity of the research model variables, such as management supervisory capacity, in-house reporting culture, safety education, and industrial accident investigation along with the factors of carrier safety management systems, such as worker safety awareness and safety behavior, a confirmatory factor analysis of the measurement model was conducted.

In this study, we examined suitability indices such as χ^2 statistics, standardized root mean square residual (SRMR), Tucker Lewis index (TLI), comparative fit index (CFI), and root mean square error or approximation (RMSEA). In general, although χ^2 statistics are generally suitable for $p>.05$, they are sensitive to the number of samples; therefore, other conformity indices were considered first. In general, TLI and CFI scores above .90 and SRMR scores below .08 are considered satisfactory. In the case of RMSEA, where the trust section is presented, the evaluation is considered excellent if the level is below .05, good if below .08, and normal if below .10.

Considering the suitability of the measurement model presented in Table 3, the measurement model showed generally good suitability, with χ^2 = 4.619.224 (df = 2,099, p<.001), SRMR = .051, TLI = .912, CFI = .927, and RMSEA (90% CI) = .072 (.070–.074). In addition, the load of all measurement variables on the potential factors, such as management supervisory capabilities, in-house reporting culture, safety education, worker safety awareness, and safety behavior on industrial accident investigation factors, was statistically significant ($p<.001$). The standardized factor load was overall higher than .50, and a theoretically improper distribution of the Heywood case was not found.

Next, we reviewed the construct reliability (CR) and average variance extracted (AVE) measures to examine the concentration feasibility of the potential variables. The concentration feasibility indicates the correlation between two or more measurement items for one potential variable, and CR values greater than .70 and AVE more than .50 are considered excellent. As shown in Table 4, the CR shows levels of more than .70 for the potential variables such as industrial accident survey (.970), in-house reporting culture (.958), safety education (.973), worker safety awareness (.879), and safety behavior (.881). the Average Variance Extracted were also confirmed with levels of more than .50 for potential factors such as industrial accident survey (.844), in-house reporting culture (.767), safety education (.800), management supervisory capacity (.795), worker safety awareness (.669), and safety behavior (.702).

Finally, the validity of discrimination among potential variables indicates how different one potential variable is from another. The most conservative method of evaluation is considered feasible if the average extraction value of each of the two potential variables is larger than the squares of the correlation coefficients of the two potential variables. The confirmed validity of discrimination obtained after comparing the squares of the correlation coefficients with the value of the average calculation is presented in Table 5. The square value (.682) between the in-house reporting culture and the industrial accident survey, which shows the highest correlation, is lower than the average extraction value displayed diagonally, indicating that the validity of discrimination among potential factors has been secured. Meanwhile, considering the correlation among research variables, it is evident that the management supervisory capacity, in-house reporting culture, safety education, and industrial accident investigation, which are the carrier's safety management system factors, are all correlated with the safety awareness of the worker and positively correlated with the worker's safety behavior. In addition, the worker's safety awareness was also found to be positively correlated with the worker's safety behavior.

C. Verification of Research Hypotheses

To examine the management supervisory capacity, in-house reporting culture, safety education, and industrial acci-

Table 3. Suitability of measurement model.

χ^2	df	*p*	χ^2/df	SRMR	TLI	CFI	RMSEA(90%CI)
4,619.224	2,099	.000	2.201	.051	.912	.927	.072(070–.074)

Table 4. Results of the certification factor analysis of Telecommunications safety management system variables.

Categories			Non-standardization estimates	Standard estimate	Standard error	*t*	Construct reliability (CR)	Average variance extracted (AVE)
Industrial accident investigation	→	Industrial1	1.000	0.927			0.970	0.844
	→	Industrial2	1.020	0.915	0.045	22.604***		
	→	Industrial3	1.042	0.894	0.050	21.030***		
	→	Industrial4	1.119	0.852	0.061	18.470***		
	→	Industrial5	0.972	0.907	0.044	22.004***		
	→	Industrial6	0.993	0.820	0.059	16.873***		
In-house reporting culture	→	In-house1	1.000	0.828			0.958	0.767
	→	In-house2	0.948	0.837	0.065	14.478***		
	→	In-house3	1.011	0.845	0.069	14.676***		
	→	In-house4	1.034	0.689	0.095	10.913***		
	→	In-house5	1.164	0.902	0.071	16.360***		
	→	In-house6	1.116	0.857	0.074	15.021***		
	→	In-house7	1.162	0.889	0.073	15.985***		
Safety education	→	education1	1.000	0.777			0.973	0.800
	→	education2	0.970	0.874	0.069	13.964***		
	→	education3	0.863	0.852	0.064	13.496***		
	→	education4	1.037	0.859	0.076	13.634***		
	→	education5	1.096	0.865	0.080	13.774***		
	→	education6	1.182	0.874	0.085	13.964***		
	→	education7	1.002	0.892	0.070	14.348***		
	→	education8	1.044	0.921	0.070	14.999***		
	→	education9	1.051	0.740	0.093	11.278***		
Competency of management supervisor	→	supervisor1	1.000	0.859			0.964	0.795
	→	supervisor2	0.985	0.905	0.055	17.877***		
	→	supervisor3	0.921	0.860	0.057	16.164***		
	→	supervisor4	0.979	0.879	0.058	16.854***		
	→	supervisor5	1.050	0.852	0.066	15.824***		
	→	supervisor6	1.039	0.882	0.061	16.965***		
	→	supervisor7	1.004	0.730	0.082	12.264***		

***p<.001

Table 5. Correlation between research variables.

Categories	Telecommunications safety management system				Worker safety behavior	Worker safety awareness
	Competency of management supervisor	In-house reporting culture	Safety education	Industrial accident investigation		
Competency of management supervisor	.795	(0.539)	(0.591)	(0.476)	(0.308)	(0.573)
In-house reporting culture	.734***	.767	(0.677)	(0.682)	(0.375)	(0.635)
Safety education	.769***	.823***	.800	(0.624)	(0.316)	(0.551)
Industrial accident investigation	.690***	.826***	.790***	.844	(0.360)	(0.540)
Worker safety behavior	.555***	.612***	.562***	.600***	-	(0.460)
Worker safety awareness	.757***	.797***	.742***	.735***	.678***	-
Average	4.11	4.13	4.16	4.12	4.20	4.16
standard deviation	0.71	0.71	0.69	0.73	0.76	0.52

***p<.001; the diagonal value is the average dispersion extraction value, the correlation coefficient is the diagonal bottom value, and the ( ) value above the diagonal value is the square of the correlation coefficient.

dent investigation factors, as well as the structural causal relationship between the variables of worker safety awareness and safety behavior, an SEM analysis was conducted using AMOS 26.0. The maximum likelihood (ML) was used for estimating the parameters. First, the suitability of the research model presented in Table 6 shows that there is no

difficulty in accommodating the research results, with demonstrated values of χ^2 = 4,855.678 (df = 2,306, p < .001), SRMR = .051, TLI = .919, CFI = .920, and RMSEA (90% CI) = .074 (.071–.077). The verification results of the hypothesis of this study, which was established to determine the causal relationship between management supervisory capabilities, in-house reporting culture, safety education, and industrial accident investigation factors, as well as worker safety awareness and safety behavior variables, are presented in Table 7.

The verification result of Research Hypothesis 1 (telecommunications safety management system affects the safety consciousness of the worker), which affects the safety consciousness of the worker management supervisor capacity (standardized path coefficient = .206, t = 2.472, p<.05) and industrial accident survey (standardized path coefficient = .194, t = 2.118, p<.05) indicated a significant effect on workers' safety awareness with positive correlation. On the other hand, in-house reporting culture (standardized path coefficient = .126, t = 1.692, p>.05) and safety education (standardized path coefficient = .093, t = .053, p>.05) factors were found to have no significant impact on workers' safety awareness. These results indicate that in the safety management systems of telecommunication companies, the higher the level of management supervisors and industrial accident surveys, the higher the safety awareness of the workers. To raise the workers' safety awareness, the ability of the work-related supervisor and a thorough investigation and evaluation system in the event of industrial accidents are very important. Particularly, considering the relative influence of these factors in this study, denoted by the standardization coefficient, the capacity of the management supervisor is more influential in enhancing the safety awareness of the worker the than industrial accident survey. Thus, hypotheses 1-1 and 1-4 of this study were adopted, and hypotheses 1-2 and 1-3 were rejected.

Next, considering the verification results of Hypothesis 2 (the worker's safety awareness affects the worker's safety behavior), the worker's safety awareness has a significant positive correlation with the worker's safety behavior (standardized path coefficient = .166, t = 4.141, p<.001). This implis that the higher the safety awareness of telecom operators, the higher their safety behavior. Therefore, Hypothesis 2 was adopted.

According to the verification results of Hypothesis 3 (the telecommunications safety management system will affect the safety behavior of the worker), which affects the correlation between worker safety behavior and the telecommunications safety management system, management supervisor capacity (standardized path coefficient = .243, t = 2.296, p<.05) and industrial accident survey (standardized path coefficient = .248, t = 2.530, p<.05), among the factors of telecommunications safety management system, have a significant effect on worker safety behavior with a positive correlation. The in-house reporting culture (standardized path coefficient = .128, t = .285, p>.05) and safety education (standardized path coefficient = .134, t = .296, p>.05) were found to have no significant impact on workers' safety behavior. These results indicate that in the carrier's safety management systems, the higher the capacity of the management supervisor and the higher the level of the industrial accident survey, the higher the safety behavior of the worker. The worker's compliance with safety rules while working should be preceded by ensuring the competence of the work-related supervisor and a thorough investigation and evaluation system in the event of industrial accidents. In particular, considering the relative influence of these factors in this study, represented by the standardization coefficient, the

Table 6. Suitability of the research model.

χ^2	df	p	χ^2/df	SRMR	TLI	CFI	RMSEA(90%CI)
4,855.678	2,306	.000	2.106	.051	.919	.920	.074 (.071–.077)

Table 7. Research hypothesis verification results.

Path			Non-standardization path coefficient	Standard error	Standardized path coefficient	t(C.R)
Ability of management supervisor	→	Worker safety awareness	0.150	0.066	0.206	2.472*
In-house reporting culture	→	Worker safety awareness	0.214	0.267	0.126	1.692
Safety education	→	Worker safety awareness	0.005	-0.006	0.093	0.053
Industrial accident investigation	→	Worker safety awareness	0.111	0.015	0.194	2.118*
Worker safety awareness	→	Worker safety behavior	0.688	0.476	0.166	4.141***
Ability of management supervisor	→	Worker safety behavior	0.128	0.026	0.243	2.296*
In-house reporting culture	→	Worker safety behavior	0.065	0.056	0.128	0.285
Safety education	→	Worker safety behavior	0.040	0.034	0.134	0.296
Industrial accident investigation	→	Worker safety behavior	0.327	0.210	0.248	2.530*

*p<.005, ***p<.001

capacity of the management supervisor has a greater influence on enhancing the safety behavior of workers than the industrial accident survey. Thus, hypotheses 3-1 and 3-4 of this study were adopted, and hypotheses 3-2 and 3-3 were rejected.

Next, to verify Hypothesis 4 (worker safety awareness exerts a mediating effect between the carrier's safety management system and worker safety behavior), bootstrapping on the indirect effect of these routes was conducted. Bootstrapping is judged as meaningful at a caution level of .05 when 0 is not included in the 95% confidence section (CI) by estimating the distribution of parameters based on sample data without knowing the distribution of the population. The verification results are shown in Table 8.

According to the verification results in the table, management supervisor competency → safety awareness → indirect effect of safety behavior path (standardized path coefficient = .032, 95% CI: -.126–.175, p>.05), in-house reporting culture → safety awareness → indirect effect of safety behavior path (standardized path coefficient = .127, 95% CI: -.018–.361, p>.05), safety education → safety awareness → indirect effect of safety behavior path (standardized path coefficient = -.003, 95% CI: -.147–.127, p>.05), industrial accident survey → safety awareness → indirect effect of safety behavior path (standardized path coefficient = -007, 95% CI: -.135–.120, p>.05). All these paths contain 0 in the 95% CI, rendering the mediating effect meaningless. These results confirm that workers' safety awareness has a positive impact on their safety behavior. However, it means that telecommunication companies' safety management system factors such as management supervisory capabilities, in-house reporting culture, safety education, and industrial accident surveys have a positive impact on workers' safety awareness and, ultimately, do not have a positive impact on workers' safety behavior. Therefore, the hypotheses 4-1, 4-2, and 4-3 were rejected.

In summary, management supervisor capabilities and industrial accident investigation among telecommunication companies' safety management system factors directly affect workers' safety awareness and safety behavior, but safety awareness does not indirectly affect safety behavior.

V. DISCUSSION AND CONCLUSIONS

In this study, the effect of the safety management system of telecommunication companies on workers' safety awareness and safety behavior was empirically verified. The main empirical analysis results are as follows:

First, the impact of the telecommunications safety management system on workers' safety awareness was analyzed. As a result, management supervisor capacity on workers' safety awareness and in-house reporting culture were found to have a significant effect on workers' safety awareness, with a positive correlation. On the contrary, in-house reporting culture, and safety education had no significant impact on workers' safety awareness. These results suggest that the higher the level of management supervisors and industrial accident investigation in the safety management systems of telecommunication companies, the higher the safety awareness of the workers. Hence, for the workers to possess a raised awareness of safety, the capacity of the work-related supervisor and a thorough investigation and evaluation system in the event of industrial accidents should have higher priority. In particular, the study found that the capacity of the management supervisor has a greater influence in raising safety awareness in workers than investigating industrial accidents. This observation confirmed that thorough management, expertise, and leadership of the management supervisor are the most important factors in raising awareness of safety in workers preventing accidents during work, such as at the Korea Telecommunications Corporation.

Second, we analyzed the effect of safety awareness of telecommunications workers on safety behavior. The safety awareness of workers had a positive correlation effect on their safety behavior. These results suggest that the higher the safety awareness of telecom workers, the higher their safety behavior, which means that raising awareness of safety in workers is necessary to increase the safety behavior of workers and prevent accidents.

Third, the impact of the telecommunications safety management system on the safety behavior of workers was analyzed. The results show that management supervisor capacity and industrial accident survey, among the factors of telecommunications safety management system, exerted a significant

Table 8. Verification results of the mediating effect of worker safety awareness.

Path	Indirect effect		
	Non-standardized path coefficient	Standardized path coefficient	95% CI
Ability of management supervisor → safety awareness → safety behavior	0.034	0.032	(-0.126–0.175)
In-house reporting culture → safety awareness → Safety behavior	0.147	0.127	(-0.018–0.361)
Safety education → Safety awareness → Safety behavior	-0.003	-0.003	(-0.147–0.127)
Industrial accident investigation → Safety awareness → Safety behavior	-0.008	-0.007	(-0.135–0.120)

*Bootstrap sampling 1,000 times

effect on worker safety behavior with a positive correlation. However, in-house reporting culture and safety education were found to have no significant impact. These results indicate that in the carrier's safety management system, the higher the capacity of the management supervisor and the higher the level of the industrial accident survey, the higher the safety behavior of the workers, which suggests that the importance given to the ability of workers to comply with safety rules at work should be preceded by the capacity of the work-related supervisor and a thorough investigation and evaluation system in the event of industrial accidents. In particular, as in the case of safety awareness, this study confirmed that the ability of the management supervisor is more influential in enhancing the safety behavior of workers than the investigation of industrial accidents. This observation confirmed that the competent management, expertise, and leadership of the management supervisor are the most important factors in enhancing the safety behavior of workers to prevent accidents during work, such as at the Korea Telecommunications Corporation.

Fourth, the mediating effect of worker safety awareness was analyzed through its relationship with the carrier safety management system and worker safety behavior. The result demonstrated that telecom safety management system factors, such as management supervisory capabilities, in-house reporting culture, safety education, and industrial accident surveys have a positive impact on workers' safety awareness but, ultimately, do not have a positive impact on workers' safety behavior. These results suggest that management supervisory capabilities and industrial accident investigation factors among telecommunication companies' safety management systems directly affect the workers' safety awareness and safety behavior, but they do not directly affect safety behavior through safety awareness.

In this study, by examining the effects of safety awareness among telecommunication workers and safety management system factors on safety behavior, we have attempted provide practical basic data for suggesting ways to prevent industrial accidents in the workplace. In addition, this study was limited to the analysis of workers' awareness of safety and safety behaviors based on the awareness of the safety in workers. However, this study is academically meaningful as it has an impact on the awareness of safety and safety behavior of workers, who can prevent industrial accidents by focusing on the factors of telecommunication companies' safety management systems, such as management supervisory capabilities, in-house reporting culture, safety education, and industrial accident surveys.

However, this study has the following limitations. It considered the result of only 196 workers in one telecommunications company in Korea. Therefore, the results for domestic telecom workers not included in this survey may be different because the safety management systems may be different in each telecom company. Therefore, there may be limitations in generalizing the results of this study. Therefore, in the follow-up study, more generalized results need to be derived by comprehensively expanding the scope of this study by including all three domestic telecom companies.

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