

A plan to improve the safety management system centered on the orderer for the reduction of construction accidents

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Abstract

Background/Objectives: Even though the number of accident deaths in the construction industry in 2019 was 428, down 57 from 485 compared to 2018, the number of deaths per 10,000 people in construction accidents increased from 1.65 to 1.72. This reason is because the number of workers in the construction industry decreased by 450,000 from the previous year. It is time the government policy needs to be reviewed.

Methods/Statistical analysis: Through a literature study on the construction safety management system and a survey analysis of construction site experts, it is intended to derive a plan for improvement of a client-oriented safety management system. To this end, in this study, the questionnaire items were completed through the consultation of 10 construction site experts who have been in the construction industry for more than 10 years, and 235 professionals in the construction industry were surveyed.

Findings: It is considered that the following measures to improve the construction safety management system are necessary. First, it is necessary to obtain a voluntary certification of the construction industry safety and health management system and to operate it obligatory. Second, it is necessary to create a safety management support guideline, safety and health

education, and participation in activities for the orderer to raise their active interest in safety and health and a sense of responsibility. Fourth, it is necessary to increase the weight of the evaluation items for safety management activities and the amount of direct support for safety expenses by site and safety management activities in the

management evaluation items of public institutions every year. Fifth, on behalf of the orderer Supervisors who have experience in safety management should be assigned an experienced person in safety management, and an institutional arrangement should be prepared to utilize private agencies and competent safety experts. Sixth, when reporting the appointment of the site manager and safety manager to the local labor office, the special work must also include the work supervisor in charge.

Improvements/Applications: It is necessary to shift to a orderer-centered safety management system rather than the on-site response method during the construction stage. The results of this study are expected to be of great help in establishing construction safety policies.

Keywords: Construction, Disaster Reduction, Orderer, Role Improvement, Safety Management.

1. Introduction

Even though the number of accident deaths in the construction industry in 2019 was 428, down 57 from 485 compared to 2018, the number of deaths per 10,000 people in construction accidents increased from 1.65 to 1.72. This reason is because the number of workers in the construction industry decreased by 450,000 from the previous year[1]. Although the Ministry of Employment and Employment changed the Occupational Safety and Health Act to reduce industrial accident deaths and poured out budget and manpower, the increase in the number of accident deaths in the construction industry is a serious problem, and it is the time when the government policy needs to be reviewed[2].

Table 1: Construction industry accident deaths

Category	Total			Public institutions			Private institutions		
	2 0 1 8	2 0 1 9	Difference	2 0 1 8	2 0 1 9	Difference	2 0 1 8	2 0 1 9	Difference
Total (persons,%)	485	428	△57	121	81	△40	364	347	△17
Less than 5 billion	323	283	△40	85	48	△37	238	235	△3
5 billion~30 billion	64	55	△9	27	16	△11	37	39	2
More than 30 billion	87	84	△3	9	17	8	78	67	△11
Etc	11	6	△5	-	-	-	11	6	△5

(Source: Ministry of Employment and Labor)

Until now, the safety management of domestic construction projects has been carried out by the contractor, mainly focusing on the punishment and censure of the site manager and supervisor of the construction site in case of a safety accident[3]. Although the orderer's safety responsibility has been reinforced through recent legal amendments, fundamentally, the change of consciousness and qualification of the orderer and the supervisor on behalf of the orderer have not been properly implemented. Therefore, through a literature study on the construction safety management system and a survey analysis of construction site experts, we intend to derive a plan to improve the safety management system centered on the orderer[4].

2. Literature Review

2.1. Foreign status

In the case of advanced countries, safety regulations are being reinforced, and the direction of safety management for construction works is evolving into safety management at the design stage, focusing more on accident prevention through safety management led by the orderer. In particular, in the UK, HSE (British Safety and Health Organization), orderers, and industrial accident insurance companies are participating in safety supervision. The orderers have the roles and responsibilities for the safety and health of workers in the entire construction process, too[5,6].

Suraji[7] said budget reduction, design change, and reduction of construction period by the orderer through a construction accident occurrence model are an important cause of safety accidents and in order to set a standard for safety measures in the planning and design stages, the participation of the orderer and strengthening the role are important [8,9,10].

2.2. Domestic status

The domestic Occupational Safety and Health Act specifically mentions the responsibility of the construction contractor for safety and health management and the responsibility of the client in various articles. For example, among the duties of the Occupational Safety and Health Act Article 4, the government's responsibility for disaster prevention support and guidance, Article 5, the person who orders, designs, and constructs construction products during the business of the business owner, and the arrangement of

the safety and health coordinator under Article 18 (2) Article 31 safety and health education, promotion of activities to prevent industrial accidents in Article 62, and the provisions of safety and health measures for contract projects under Article 29 specifically mention the safety[11].

However, the practical requirements for participation in safety activities, sharing of responsibilities, and safety support of the orderer are not defined. However, only the obligation to change the design in the event of a disaster such as the prohibition of reduction of the construction period, the delay of construction start or the suspension of construction by the orderer, and the risk of a disaster such as the collapse of temporary structures are partially specified. In addition, under the Construction Technology Promotion Act, on-site construction supervisors are required to collectively manage construction, but at construction sites, technical supervisors who lack safety knowledge and experience are in charge of safety management on behalf of the orderer[12,13]. Due to this, the orderer decides the relationship with all construction participants, including the builder, the supervisor, and major issues of safety management, but does not want to exceed the role limits of the supervisor, an agent of the orderer. However, the supervisor cannot establish rapid safety measures due to lack of safety management ability, lack of conviction for concurrent work, and limited decision-making power. Therefore, the domestic construction safety management system is inevitably operated based on the responsibility of the contractor. Such a construction safety and health management system can reduce the accident rate of construction works in the short term through government regulation and interference, but it will not be a fundamental disaster reduction plan. Above all, it can be said that the participation of the orderer in the safety management system is very important for the continuous reduction of the construction accident rate[14,15].

2.3. Problems of the domestic construction safety system

The domestic construction safety system specifically deals with the responsibilities and punishment of the employer, but practical matters necessary for participation in safety activities, sharing of responsibilities, and safety support of the orderer are not stipulated, and only the responsibilities of the orderer are comprehensively prescribed. In addition, the responsibility of the orderer under the Framework Act on the Construction Industry also focuses on the quality construction,

environment, and safety of facilities. At the site, one construction supervisor manages the quality, process, environment, and safety of many sites, and the supervisor, an agent of the orderer does safety management. But the effectiveness of safety management is deteriorating because a technical person who is not specialized in safety knowledge and experience is concurrently or in charge of the job[6,7,12].

3. Materials and Methods

In this study, the questionnaire items were completed through the consultation of 10 construction site experts who have been in the construction industry for more than 10 years, and in five domestic regions (Gyeonggi/Seoul/Incheon, Chungcheong/Daejeon/Sejong, Gyeongsang/Busan/Daegu/Ulsan, Honam. / Gwangju / Jeju, Gangwon) survey was conducted on 235 professionals in the

construction industry. Excluding the questionnaire with poor answers, data of 208 people (88.5%) were analyzed using the SPSS25 statistical program. Statistical analysis was performed by extracting and analyzing 3 factors with high importance for each item out of the 4 items of the role of the orderer, which are independent and dependent variables, and the 3 items for activating the operation of the safety and health management system.

3.1. The composition of the questionnaire

As shown in Figure 1, the questionnaire is consisted of 8 for responsibility for accidents, 6 for safety management expenses, 6 for using safety experts, 5 for participation in safety activities, 7 for introduction and operation of the safety and health management system, 9 for system activation, and 9 for system connection.

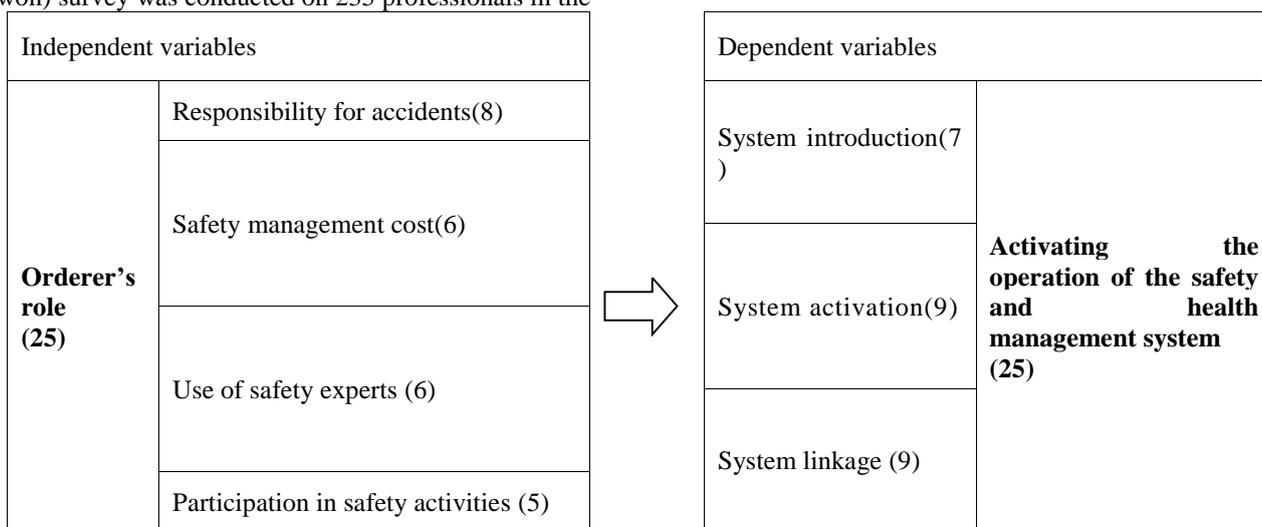


Figure 1. Questionnaire composition

3.2. Survey analysis

3.2.1. Respondent's general status

Respondents belong to 16 (6.8%) orderers (supervisors), 1 designer (0.4%), 41 supervisors (17.4%), 115 general construction companies (66.0%), 11 specialized construction companies (4.7%) etc. Work experiences was divided by 6 people under 2 years (2.6%), 20 people under 2-5 years (8.5%), 35 people under 5-10 years (14.9%), 29 people under 10-15 years (12.3%), 144 people for more than 15 years(61.3%). The type of construction at the site was 59 people civil works sites (25.1%), construction sites 131 people (55.7%), plant sites 16 people (6.8%), electricity and information communication sites 20 people (8.5%), headquarters 7 people (3%) etc. In this way, many practitioners who are directly experiencing safety management and execution participated, thereby increasing the reliability of this study.

3.2.2. the role of the orderer

As shown in Table 2,3,4,5, the role of the orderer in the construction site was analyzed by dividing into four items, such as a sense of responsibility for accidents, cost of safety

management, use of safety experts, and participation in safety activities.

3.2.2.1 Consciousness of responsibility of the orderer in case of an accident (see Table 2)

The orderer's responsibility for the occurrence of an accident at the construction site was 3.82 out of 5 points, the effect of the orderer's safety on construction accident reduction was 4.06 points, and the reinforcement of the orderer's safety management role for preventing of construction accidents 3.99 points, and the side effects of the reinforcement of the orderer's safety management role were 3.22 points. This means that it can be seen that the responsibility of the orderer is large at the construction site, and the sense of responsibility of the orderer is very helpful in preventing construction accidents. On the other hand, when reinforcing the role of the orderer's safety management, it is worth noting that there are some opinions that are concerned about side effects such as delays in ordering due to the burden of responsibility of the orderer and unnecessary paperwork to avoid responsibility.

Table 2: Orderer's sense of responsibility for accidents at construction sites

Category	Mean	Percentage(%)
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Responsibilities of the orderer for accidents on the construction site	3.82	76.4
The effect of the orderer's interest in safety on disaster reduction	4.06	81.2
Reinforcing the role of the orderer is helpful in preventing disasters	3.99	79.8
Side effects that occur when reinforcing the safety management role of the orderer	3.22	64.4

3.2.2.2. The role of the orderer in terms of safety management cost(see Table 3)

When the safety and health management expense payment rate is expanded, the effect of accident prevention was 4.16 points, the transparency of the on-site safety and health management expense was 3.86 points, and the appropriateness of safety management expenses under the Construction Promotion Act was 3.57 points. These results show that in order to reduce construction accidents, it is effective to increase the payment rate of safety and health management expenses paid by the orderer by about 3%, and it is necessary to improve the transparency of the execution

of safety and health management expenses. In addition, if there is material provided by the orderer at the construction site, the adequacy of safety management fees paid for the purpose of external traffic signals, etc. received a relatively low score, but it is judged from the lack of understanding on the details. The improvement plans(see Table 4) about this are such as direct cost conversion of safety facility cost items for temporary construction works (56.7%), expansion of items used for safety and health management expenses (49.2%), direct support of the orderer in case of delay caused by design change (35.2%), and simplified proof of safety and health management costs use (27.1%) etc.

Table 3: The role of the orderer in terms of safety management cost

Category	Mean	Percentage(%)
The effect of disaster prevention when increasing the payment rate of safety and health management expenses	4.16	83.2
Transparency of execution of on-site safety and health management expenses	3.86	77.2
Whether the safety management cost is appropriate under the Construction Promotion Act	3.57	71.5

Table 4: Improvement measures for safety and health management costs at construction sites

Category	Frequency (Duplicate response)	Percentage (%)	Priority
Expansion of direct support to orderers in case of delay in design change	83	35.2	3
Expansion of items used for safety and health management expenses	116	49.2	2
Simplify proof of use of safety and health management expenses	64	27.1	4
Conversion of safety facility cost items for temporary construction into direct costs	133	56.4	1
Etc	3	1.3	5

3.2.2.3. Use of safety experts in construction site (see Table 5)

2.8 points of expertise of the safety supervisor deployed at the site, 3.0 points of disaster prevention effect when placing the site safety supervisor as a professional, 2.74 points of awareness of responsibility felt by the site supervisor in the event of a site disaster, on-site inspection by a private safety agency, and When expanding consulting, the effect of disaster prevention was 3.38 points. These results indicate

that the expertise of the safety supervisor deployed at the site and the awareness of responsibility felt by the site supervisor in the event of a disaster are somewhat negative and insufficient. Therefore, it was found that it was necessary to arrange professional positions of on-site safety supervisors and to expand on-site inspection and consulting by private specialized agencies. Therefore, the orderer must assign construction experience personnel (construction safety engineer, industrial safety engineer, etc.) with experience in

safety management work as safety supervisors, and provide an opportunity to participate in safety competency

strengthening training and activities to them to raise the responsibility awareness

Table 5: The role of the orderer in utilizing construction site safety experts

Category	Mean	Percentage (%)
Degree of expertise of safety managers deployed on site	2.80	56.0
The effect of disaster prevention when the on-site safety supervisor is assigned as a professional	3.90	78.0
Degree of awareness of responsibility felt by on-site supervisors in the event of a disaster	2.74	54.8
Effect of disaster prevention when expanding on-site inspection and consulting by private safety specialists	3.48	69.6

3.2.2.4. The role of the orderer in the aspect of participation in safety activities(see Table 6)

3.57 points for the appropriateness of the intensity of frequent safety checks by the orderer and supervisory authority, 3.33 points for the effectiveness of disaster prevention by participating in the orderer and supervisor in risk assessment activities, 2.82 points for the recognition of the responsibility of the orderer in the event of a disaster after the orderer safety

check activity, The degree of consistency was 2.52 points. These results indicate that the ordering and supervisor's participation is appropriate when evaluating the strength and risk of frequent safety inspections conducted by the orderer together with the supervisory authority, but the perceived responsibility of the orderer in the event of a disaster after on-site inspection activities and the degree of consistency of the orderer's safety inspection activities are somewhat negative.

Table 6: The role of the client in terms of participation in on-site safety activities

Category	Mean	Percentage (%)
Appropriateness of the intensity of frequent safety inspections by the orderer and the supervisory authority	3.57	71.4
Disaster prevention effect in case of participation of orderer and supervisor in risk assessment activities	3.33	66.6
Recognition of responsibility in case of a disaster after safety inspection activities of the orderer	2.82	56.4
Consistency level when participating in on-site safety inspection activities of the orderer	2.52	50.4

3.2.3. Analysis of the operation status of the orderer's safety and health management system

As shown in Table 7, 120 out of 235 people (51%) that the orderer operates the safety and health management system. Also, the most common safety and health management system certified by the orderer was KOSHA 18001 (49%), ISO 45001 (27%), KOSHA-MS (16%), and OHSAS 18001

(8%). Besides, If you look at the status of certification acquisition, 97 (81%) orderers have one certification among the four safety and health management systems (OHSAS 18001, ISO 45001, KOSHA 18001, KOSHA-MS), and 16 orderers have two certifications (13%), 5 orderers have 3 certifications(4%), and 2 orderers have all 4 certifications(2%).

Table 7: Operation Status of the Orderer's Construction Site Safety and Health Management System

Category	safety and health management system				Total	Percentage (%)	
	OHSAS 18001	ISO 45001	KOSHA 18001	KOSHA-MS			
Number of	1	4	25	55	13	97	81.0
	2	7	9	12	4	16	13.0
	3	0	5	5	5	5	4.0
	4	2	2	2	2	2	2.0

	Certification total	13	41	74	24	120	100
	Percentage (%)	9.0	27.0	49.0	16.0	100	

As shown in Table 8, 104 (45.3%) answered that the orderer's safety and health management system contributes to disaster prevention largely. This means that the system is very necessary for disaster prevention. The main reasons(see Table 9) were fundamental risk management (62%) through preliminary risk assessment from the initial stage, motivating

the heads of public institutions after certification (60%), establishment of the organization's health and safety management system (57%) , safety and health organization reinforcement (26%), and occupational placement in safety and health (21%).

Table 8: Contribution to accident prevention of the orderer's safety and health management system

Category		Frequency	Percentage		Cumulative %
			%	Right %	
Valid	Verry small	4	1.7	1.7	1.7
	Small	26	11.1	11.3	13.0
	Normal	96	40.9	41.7	54.8
	Big	91	38.7	39.6	94.3
	Very big	13	5.5	5.7	100.0
	Total	230	97.9	100.0	
Missing value	System	6	2.1		
Total		236	100.0		

Table 9: Reasons for the contribution of the orderer operated safety and health management system to disaster prevention

Category	Frequency	Percentage(%)	Ranking
Motivation of public institution heads after certification	62	60	2
Fundamental risk management through preliminary risk assessment from the initial stage	64	62	1
Establishment of the organization's health and safety management system	59	57	3
Strengthening the health and safety organization	27	26	4
Professional placement in health and safety	22	21	5

104 people answered that the orderer's safety and health management system certification helps to improve the level of safety management was helpful. Also, 136 people voted in favor of the mandatory introduction of the safety and health management system by the orderer at the site of a major disaster, and 25 voted against it.

4. Results and Discussion

The main reason that the accident rate of domestic construction projects is not significantly reduced is that the change and settlement from the contractor's regulation and

punishment-oriented policy to the orderer-centered safety management system has not been properly settled. In order to secure the safety management of the construction industry, mutual cooperation between the construction participant organizations such as the orderer, the designer, the supervisor, and the constructor is essential during the life cycle of planning, design, construction, maintenance, and dismantling. In particular, the orderer is the owner of the finished product after the final construction is completed, and exercises direct and indirect authority as a supervisor, such as the selection authority of the construction participant, and the budget and payment of funds, but the responsibility for construction safety is very weak . Therefore, in order to reduce

construction accidents, it is necessary to settle the orderer-centered safety management system as soon as possible. For this, it is considered that the following measures to improve the construction safety management system are necessary.

First, it is necessary to obtain a voluntary certification of the construction industry safety and health management system and to operate it obligatory. Second, it is necessary to produce a safety management support guideline for the orderer, and to participate in safety and health education and activities in order to raise an active interest in safety and health of the orderer and a sense of responsibility. Third, institutional support is urgently needed to expand the payment rate of standard safety management fees under the Occupational Safety and Health Act and safety management fees under the Construction Promotion Act. Fourth, it is necessary to increase the weight of the evaluation items on safety management activities and the amount of direct support for the orderer's site-specific safety costs in the management evaluation items of public institutions every year. Fifth, the supervisor who represents the orderer should arrange an experienced person in safety management, and establish an institutional mechanism that can utilize private agencies and competent safety experts. Sixth, when reporting the appointment of the site manager and safety manager to the local labor office, the special work must also include the work supervisor in charge.

5. Conclusion

Construction accidents frequently occur in the process of urgent work for settling change problems in construction methods after the construction stage without sufficient review at the planning and design stage led by the orderer. Therefore, it can be said that the interest of the orderer and the participation of safety experts in the early stages are essential elements of disaster prevention. The authority and responsibility of the orderer cannot be entrusted to the construction company, and cannot be delegated to the supervisor who represents the orderer. In construction, the work method determined by the orderer at the planning stage, calculation of the construction period, participation of safety experts, placement of safety supervisors, accounting of safety management expenses, introduction of a safety and health management system, and safety activities of the orderers have a significant impact on the construction safety. The safety is most important even in the inevitable of observing the schedule for construction completion or excessive execution of the budget. Therefore, in this study, the importance of the orderer's role of construction project and ways to strengthen the role were suggested. In order to reduce construction accidents based on the results of the study, it is necessary to shift to a orderer-centered safety management system, which is the fundamental response method before construction commencement, rather than the on-site response method during the construction stage. These findings are expected to be of great help in establishing construction safety policies to reduce the accident rate in the domestic construction industry. In the future, there will be a need research for improvement plans of the construction industry's safety and health management system operation.

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