

## **A Case Study of Disaster Accidents at Construction Site Based on PDCA Theory**

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### ***Abstract***

*This study is significant in determining the reduction of safety accidents by applying PDCA's theory by subdividing it into a case analysis technique for construction sites by PDCA's theory. For this study, accidents accounted for the largest proportion of each type of disaster in the construction site were considered, and safety accidents were reduced through the PDCA theory through prior research. The analysis method of this study derived improvement plans by applying PDCA techniques to plan, implement, confirm, review, and improve disaster accidents at construction sites. The conclusions of this study are as follows. In the plan, first of all, measures shall be taken to prepare a safety management plan, to verify the implementation of the plan, and to verify the degree of implementation by the field manager. In the implementation, first of all, it is necessary to introduce a safety education history system to strengthen the safety education curriculum to suit the site, as long-term work is impossible for field workers depending on field conditions. First of all, it is necessary to strengthen the installation of safety facilities, including "work scaffolding" and "conducting prevention facilities" at construction sites. In management review and improvement, the risk assessment system for construction sites needs to be expanded first<sup>o</sup>.*

**Keywords:** Construction Works, Industrial Accidents, PDCA, Disaster Prevention

## **1. Introduction**

### **1.1 Necessities**

Despite the national economic development, the high-quality education level, and the governmental/policy-level efforts, the industrial accidents in the construction industry are not significantly improved, and the social loss by disaster accidents is more increasing.

According to the data of Korea Occupational Safety & Health Agency, the number of deaths and victims in

the construction industry took the first place [1], and the types of accidents were a lot shown in the order of falling, falling over, getting hit by an object, getting amputated, a cut, and stabbed, getting bumped, and getting

jammed, and the case of falling took up the biggest weight. As the disaster accidents frequently occur in the parts vulnerable to safety management at small/medium construction sites, the government has difficulties to guide and supervise them. Especially, due to the aged domestic construction workers and the inflow of foreign workers in construction sites, both managers and workers have the low perception of safety, which is led to the increase of accident rate. In other words, compared to various risk factors at sites, the workers' safety consciousness was insufficient, so the construction industry showed the higher accident rate than other industries.

According to Yoo Hee-Jae(2017), the complex construction works are performed at the same time in construction sites, so the safety management system is not working properly. Also, both managers and workers are lacking in the efficient safety management such as non-assignment of skilled workers and non-completion of safety management plan, which is contributing to the continuous increase in accident rate and the number of victims [2].

According to Kim Se-Hoon(2021), as a case of the safety health management system of construction industry, the risk assessment as an activity to remove/reduce risk factors is smoothly introduced and settled down in the Korea Occupational Safety Health Agency Management System for Construction Industry, and the safety process of general construction companies, so the safety system and the cyclical safety management system of PDCA are operated in domestic general construction companies and specialized construction companies [3].

In the results of analyzing the disaster accident statistics of construction industry by Korea Occupational Safety & Health Agency, total five types of accidents such as falling, falling over, overturning, getting bumped, getting jammed, getting amputated, and getting a cut take up the high weight. In the small/medium construction sites with lots of accidents, the safety management was not fully working, so the accident rate was extraordinarily higher than advanced countries. To reduce the accident rate and safety accident rate, the government or construction personnel from owner should put efforts and researches on support, safety education, and level of safety consciousness

## **1.2 Preceding Researches**

Yoon Kyung-Joon(2021) understood the current accident status in the construction industry and the problems of small-size construction sites based on the statistical data of Korea Occupational Safety & Health Agency, and also comparatively analyzed the foreign safety management system [4].

According to Kim Nam-Soo(2020), the falling accident occurs when a worker performing the high-place work falls on something like the ground. The disassembling work is performed at a high place, and this accident causes the biggest number of deaths in every industrial/construction site. The researcher sought for the improvement measures by analyzing the causes for accidents in the subject sites for screening the hazard risk prevention plan and non-subject sites for screening, and also analyzing the cases of technical/managerial problems [5].

To understand the current status of construction industrial accidents, Woo Sue-Kyeong(2020) analyzed the cooperative governance & policy tools, main roles of doers related to industrial accident preventive policies, and interactions between subjects, by analyzing the industrial accident statistics announced by the Ministry of Employment and Labor [6].

Kim Dong Wook(2019) said the site & safety managers should preferentially control the workers' unsafe acts to reduce the accidents in the construction industry, also evaluated the importance of thorough acceptance inspection in case when carrying the construction materials and equipment in sites, and implanting the importance of pre-inspection/maintenance in the equipment operator [7].

Lee Sang-Guk(2017) analyzed the measures for improving the safety management system through a survey

by collecting the data for analyzing the owner safety management system and current accident status based on PDCA theory, and then drawing some problems [8].

Lee Byung-Kwan(2019) conducted a survey by reviewing the influence of safety consciousness on the causes for construction industrial accidents, and the factors affecting the will to obey the safety regulations targeting workers and managers, and also drawing the institutional problems for effective safety management of the safety health management system [9].

Kim Ho Gyeom(2018) conducted group or individual interviews with supervisors and site managers, and through those interviews, the researcher measured the level of execution to be equipped with the continuous feedback system of major safety activities of construction sites including risk assessment such as Plan(Planning stage), Do(Execution stage), Check(Inspection stage), Action(Action stage), and lastly, Feedback on insufficient parts and problems [10].

Song Chang-Sub(2014) used the questionnaire to analyze the problems of accident occurrence, targeting the site managers and safety/health staffs from the headquarters of business regarding the improvement measures for the safety health management system of specialized construction companies [11].

### **1.3 Differentiation from Preceding Researches**

Most of the previous researches were the empirical analysis to reduce safety accidents through the frequency analysis and interview with experts based on the cases of construction work accidents. They also mentioned the corrective action and improvement measures for the improper quality of construction and site safety education, by conducting a risk assessment on the safety health management system to understand the problems with safety management of construction companies.

This study aims to improve the P-D-C-A by concretely classifying the case analysis on disaster accidents at construction sites based on PDCA theory through the cyclical management of P-D-C-A safety management plan.

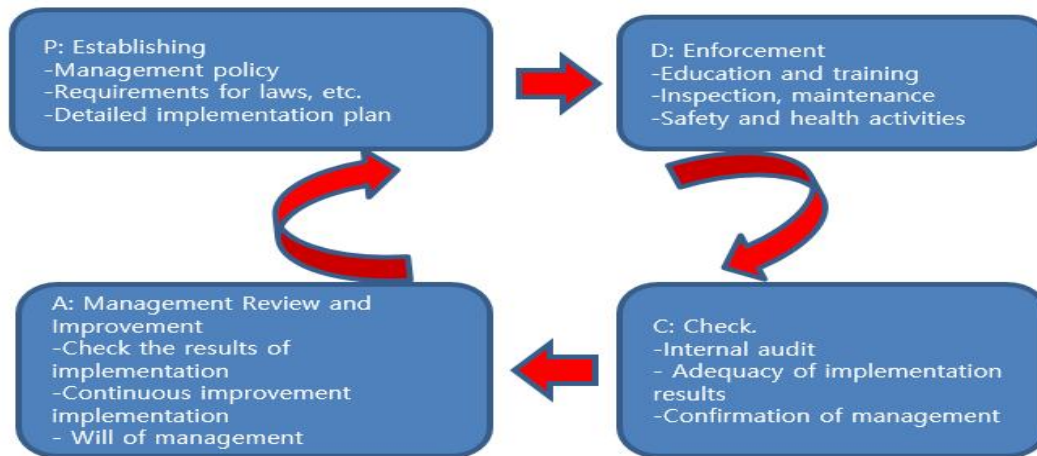
### **1.4 Objectives**

Various risk factors are existing in construction sites. The accidents could be reduced depending on the site managers/workers' perception and management of risk factors. The objectives of this study are to explore the problems of risk factors in construction sites, to analyze the causes for accidents in each type of accident, to analyze the problems through PDCA theory, and then to present the improvement measures.

## **2. PDCA Theory**

### **2.1 Composition of PDCA Theory**

As a cyclical system improvement operating model, the "PDCA Model" is called 'Deming Cycle', and also known as Deming Continuous Improvement Spira. Just as Figure 1, the theory connects the repetitive stages in the logical order like Plan, Do, Check or Study, and Act. It was designed by a statistician Walter A. Shewhart who introduced the concept of Plan, Do, and See in the 1920s. W. Edwards Deming transformed and developed Shewart's Cycle into four stages as follows.



**Figure 1. PDCA Theory**

This is the continuity of a process of continuously checking and improving the execution and plan even after achieving the goals by repetitively continuing the safety management cycle. The Plan stage is to plan works based on the prediction of work performance. The Do stage is to perform works following the plan. The Check stage is to check the results of following the plan of changed work. The Act stage is to check the parts unsuitable for the plan, and to present the improvements, which is repetitively continued.

## 2.2 Components of PDCA Theory

To get prepared for the regulations like safety construction plan and safety plan, the Plan is concretely performed while the safety management process is monitored and checked. The improvement act is sought for to continuously improve the safety at construction sites, which is the process of Plan, Do, Inspect, Check, and Act.

The autonomous safety health management system is the basic concept of eventually preventing accidents by improving the safety health management system of workplace, by reflecting the safety health policy into the corporate management policy led by the business owner, prescribing the operation standard like all sorts of guidelines and manual for performing this policy as the corporate bylaws, planning and applying it, evaluating the applied results through self-inspection, and then drawing the improvement measures and reflecting them to its system.

The autonomous safety health system is composed on the basis of P-D-C-A Cycle. Those English alphabet initials(P-D-C-A) that mean the plan(Plan), execution & operation(Do), inspection & corrective action(Check), and continuous improvement(Action), are the basic concept of systematic safety health activities of autonomous safety health system. An owner should set the safety plan as the basic plan of Plan. As the detailed plan of Plan, the owner sets the safety construction plan. In Plan, the planner records the requirements for securing the safety in construction sites as documents, and makes sure the interested parties to execute them. In Plan stage, the owner executes the safety management at construction sites based on the safety construction program. The confirmer and owner monitor(Check) the execution(Do) by reflecting the safety construction and safety plan, and if there are errors, they provide the instruction. After the contractor checks(Check) the situation of execution(Do), if there are any errors, they are improved. Such safety manager and contractor of engineering companies monitor and check(Check).

The results of checking(Check) are recorded as documents, and then shared with the interested parties. In the

improvement action(Act), based on the results of monitoring and checking(Check), the owner reviews the concrete methods of safety measures and management system, and seeks for the improvement measures. After improving the safety construction plan and safety plan, they are shared with the construction participants. The owner's engineer reviews the submitted items. In the improvement action(Act), when improving the safety construction plan and safety plan, the owner should open the written contents to the construction participants. In case when the work is changed, the workers engaged in the work should get educated about the contents before starting the relevant work. The components are as <Table 1>.

**Table 1. Components of PDCA**

Stage	Component	Main contents
Stage 1	Establishment of a plan(P)	Reflecting the risk assessment and legal requirements Concrete execution plan for achieving the goals Defining the method of means and accreditation measurement index
Stage 2	Execution(D)	Structure and responsibility for carrying out the plan Education, training, and qualifications for execution Provision of communication means Documentation and document management Safety health activities Preparation for and response to emergency situations
Stage 3	Performance measurement & internal examination(C)	Understanding the safety health performance Drawing the matter of achieving the goals and complementations
Stage 4	Manager's review & improvement(A)	Continuous security of effects of suitable and valid system Setting up the goals in the level of responsibility and performance

### 2.3 Necessity of PDCA Theory in Construction Sites

Due to the operation method or environmental characteristics, the construction work has many latent dangerous elements, so the frequency of accident occurrence is high.

According to Bae Tae-Won(2014), a lot of serious accidents are caused by carelessness based on the lack of consciousness and easygoing judgment in construction sites. The managerial hardship of small/medium-sized construction companies is not caused by a single specific problem, but based on complex and vulnerable problems in many sectors [13].

In the perspective of casualty and accident, it would be necessary to raise the perception of safety management, and also to gradually increase the executive ability to improve the safety management system by putting the best effort into the prevention of disaster accidents. As the occurrence of construction disaster accidents has huge effects on the delivery of work information about safety action, it would be needed to provide the thorough safety health education at ordinary times. In case when a new worker is working on hazardous work at site, when the contents of work is changed, and when a new safety manager is directly directing/supervising the construction workers, what is important here is the accident reduction management measures.

The construction workers need to make efforts for respecting human life, forming the pleasant working environment and the sound development of construction industry according to the relevant regulations, and

fully performing the safety measures.

This study aims to secure the virtuous cycle safety management system by applying the PDCA theory to each risk type at construction sites and improving the problems with the safety management plan. If the autonomous safety health system at construction sites is composed on the basis of P-D-C-A Cycle for the cyclic management, the safety accidents could be reduced at construction sites.

### **3. Actual Status of Disaster Accidents in Construction Sites**

#### **3.1 Establishment of a Plan**

##### **3.1.1 Safety Policy & Goals**

In many cases, the characteristics of the planned construction and the site manager's will are not reflected into the work situation in the safety policy and goals. And it could be understood as the insufficient management of corporate safety manual policy method & procedure. In the stage when the site workers install forms, more various types of accidents occur than other stages, so the safety goal would be important.

When a worker hangs goods by using an aerial work platform, the worker could be overturned by an obstacle on the ground, or crash into a structure in the unstable state.

As the worker is working and operating in the upper part, the aerial work platform could be overturned by the relation between winding load and operating radius. In case when the alarm does not automatically go off when getting close to the moment of overturn by extending the operating radius after hanging the load, and in case when the movements like traversing, winding, and waving are not restricted when lifting up a load heavier than the rated load, such disaster accidents could occur in case when the management of safety manual policy method & procedure is insufficient, and the site manager does not reflect the environmental situation into the work site.

##### **3.1.2 Review on Regulations & Risk Assessment**

It could be understood as insufficient procedure/operation of registration and management of regulations related to safety management, insufficient connection and feedbacks with risk assessment by writing the risk operation plan, and insufficient drawing of risk factors in the risk assessment.

When the operating vision is limited by noise, dust, and vibration at construction sites, the normal operation of aerial work platform is disrupted. Due to the lowered cognitive ability, the aerial work platform could be overturned. This accident could occur because the safe working conditions were not secured by checking the appropriateness of installing the safety facilities following the work method on the aerial work platform after writing a site hazardous risk prevention plan before working on the aerial work platform.

In case when the aerial work platform that looks hazardous at sites does not get the safety inspection through the safety certification system, the disaster accidents could occur. A lot of aerial work platforms are personally owned. Thus, in case when they are used at sites without getting the appropriate test on electricity, machine, safety system, and structural intensity according to the safety certification standard, such disaster accidents could occur.

Even the aerial work platform that acquired the safety certification could cause the occurrence of accidents if its maintenance/management is not properly performed in the process of use. It means that such aerial work platforms should periodically get tests on the performance appropriateness and safety system through safety inspection for the prevention of disaster accidents.

## **3.2 Execution**

### **3.2.1 Education, Training, & Qualifications**

It could be understood that there is neither systematic program about safety area of construction process, nor the measures for expanding the educational opportunity for securing the expertise and strengthening the safety operation management of system members such as safety department, site safety manager, and supervisor. There are huge casualties caused by not wearing personal protective gears while working on the aerial work platform. In case when a worker does not wear a safety helmet in the moment when the aerial work platform is overturned after crashing into an upper structure, more severe casualties could occur.

As each individual could differently feel the risk of high place work depending on their psychological characteristics, the workers or operators at high place without sufficient safety education knowledge about high place work, could cause disaster accidents through unsafe acts or mistakes at high place.

### **3.2.2 Organizational Structure, Responsibility, Communication, and Provision of Information**

In construction sites, there are many temporary workers, insufficient safety management operation system, and lack of safety inspection and safety management accident analysis in each process. Also, the accidents could occur because of poor cooperative relations between workers, and insufficient connection and procedure of communication and provision of information. The unskilled operation of aerial work platform could cause casualties. For the installation/deconstruction of structure on aerial work platforms, the position and height should be frequently adjusted. In case when it is operated by an unexperienced worker, and crashes into a structure, and when there is no safety manager at site, and insufficient communication about operation method between workers, the disaster accidents could occur.

## **3.3 Checking**

### **3.3.1 Corrective & Preventive Actions**

It could be understood as insufficient discovery/improvement activities of additional latent risk factors, and insufficient carrying-in and management of machine, equipment, facilities, and materials related to the work process through inspection activity, or formal corrective/preventive actions in daily safety inspection of main risk factors performed by safety management supervisor and safety manager.

The disaster accidents could occur when there are no preventive actions like examining if the work order was properly written, by visiting the work site in advance before operation, to check the state of structure, mechanical defect, state of working space, and ground gradient, state of material load, and state of ceiling insert installation before high place work.

### **3.3.2 Internal Examination & Evaluation/Management of Partners**

It could be understood as insufficient internal examination of site system, and insufficient operation and procedure of limiting the qualifications for corporate internal examiners to competent people and people who completed the system education. It could be also understood that there is no evaluation process improvement plan reflecting the measures for evaluating the headquarters of partners for the smooth management of site by selecting proper partners in advance based on the practical evaluation standard of the headquarters of partners. It would be necessary to prevent disaster accidents by limiting the work by unqualified people through the operation of high place work safety education program and education for understanding the acrophobia, psychological characteristics, unsafe acts, and workers' mental state while performing the high place work. The disaster accidents occur when the work is performed without taking actions to prevent overturn, without arranging a signalman who could induce the prevention of overturn in case of work using the aerial work

platform, without fully evaluating the construction safety of partners or conducting the internal examination on if the safety signal method was decided for moving, and the operator was fully prepared for work by operating at the signal.

### **3.4 Manager's Review & Improvement of Problems**

#### **3.4.1 Manager's Review**

It could be understood as insufficient procedure and contents, no analytic activities based on the management items to be reviewed, and non-reflection of some items like the results of internal/external examination into the contents of a report for manager's review.

The disaster accidents could occur in case when the process of corrective/preventive actions at site work is not improved according to the results of internal/external examination on the execution of corrective action like the work procedure including the pre/post operation of high place work was delivered to and understood by every class within the organization.

#### **3.4.2 Continuous Execution of Improvement**

It could be understood as difficult to perform continuous improvement because of insufficient preventive/corrective actions of safety accidents related to form construction as follow-up actions according to the results of management review. The disaster accidents could occur when the alarm does not go off automatically in case when getting close to the moment of overturn by extending the operating radius after hanging the load, when the movements like traversing, winding, and waving are not restricted when lifting up a load heavier than the rated load, when the performance appropriateness and safety system are not periodically tested because of insufficient management of safety manual policy, method, and procedure even though the site manager should reflect the environmental situation into work site, when the workers or operators at high place are lacking in safety education knowledge about high place work as each individual differently feels the risk of high place work depending on the psychological characteristics, when such unexperienced workers operate and crash into structures as they have to frequently adjust the position and height when installing/deconstructing a structure at aerial work platforms, when there is no safety manager at site, or lack of communication of operation, when there is no preventive action to check if the automatic alarm system has been fully installed for the moment when getting close to the moment of overturn by extending the operating radius after hanging the load, or when crashing into a crane, ground obstacles, and structure while the worker operates at vertical height by using the aerial work platforms, when there is no evaluation/management of partner company's construction safety or internal examination on if the high place work safety education program and education for understanding the acrophobia, psychological characteristics, unsafe acts, and workers' mental state while performing the high place work is provided to prevent disaster accidents by limiting the work by unqualified people, if the work is performed by taking actions to prevent overturn after arranging a signalman who could induce the prevention of overturn in case of work using the aerial work platform, and if the safety signal method was decided for moving, and the operator was fully prepared for work by operating at the signal, when the process of corrective/preventive actions at site work is not improved according to the results of internal/external examination on the execution of corrective action like the work procedure including the pre/post operation of high place work was delivered to and understood by every class within the organization, and when the cyclical safety management system based on the establishment of a plan, execution, checking, and manager's review/improvement in the whole processes of high place work is not fully performed.



## **4. Disaster Accident Improvement Measures by PDCA Theory**

### **4.1 Establishment of a Plan**

#### **4.1.1 Strengthening the Utilization of Safety Management Plan**

It is important to prevent and prepare for the risks of site in advance based on the safety management plan, and also to reflect the improvement of safety consciousness of site manager and CEO based on the problems with the system operation into the safety management plan. It is essential to check the degree of executing the safety management plan at site.

Because of various situations according to the completion rate and construction methods at construction sites, the staff in charge should review the general process plan such as site situation, work process, and material supply before starting the construction. It would be also necessary to improve the safety management plan strengthening the legal execution.

For the realistic ability to execute the safety management plan, the management of construction should be done differentially depending on the matter of executing the safety management plan. By legally specifying the approval institution for checking the execution of safety management plan, the legal execution should be strengthened in the connection with other legislation.

The supervisor and orderer should be able to check and manage the safety management plan within construction sites, by dividing it suitable for construction method and ordering type. It could be effective on the improvement of site that is not reflected into the safety management plan according to the completion rate. Also, in case of the workplaces where serious accidents occurred or the execution of safety management plan is poor, the degree of execution should be more strongly checked. By deciding the grade of management subjects as the improvement measures, it would be necessary to strictly check and examine the degree of executing the safety management plan.

On top of systematizing the unperformed safety management items such as change/checking of safety management plan, the disadvantage actions like imposition of fine/penalty and stoppage of construction should be strictly carried out, which would be helpful for strengthening the executive ability.

To strengthen the ability to execute the safety management plan system, it would be needed to strengthen the training & education by developing the information about major points of checking the degree of execution, and how to write the safety management plan.

It would be required to improve the safety consciousness to the level high enough to execute the safety management plan at construction sites, to strengthen the executive ability, to enhance the utilization, and also to improve the overall safety level in the construction industry.

In order to concretely reflect the safety measures and work standard in each operation stage into the detailed safety management plan for each completion rate, the specialized institution like approval institution should sequentially provide support such as continuous training and education.

#### **4.1.2 Strengthening the Supervisor's Authority**

The occurrence of accidents is closely related to the safety management organizational system, investment costs in site, and the level of safety consciousness of workers and business owner. The small construction sites without systematic management organization have less investment costs in safety, so the accident rate is highly shown.

Due to the characteristics of construction sites, the safety management member and organization are lacking. By actively utilizing the 'technical guidance for accident prevention' system, the unsafe accident factors at site could be reduced.

The technical guidance for accident prevention regarding the accident preventive action and how to use the

safety management cost from a guidance organization specialized in accident prevention, would be needed to establish the technical guidance and the autonomous safety management system.

## **4.2 Execution**

### **4.2.1 Strengthening the Safety Education**

Most of the construction site workers are the aged and foreigners, so it is very hard to find such skilled workers. Thus, it is necessary to cultivate skilled workers by educating the construction workers for a certain period of time. Once the knowledge about operation method is learnt from specialized school or training process, the accident factors caused by workers' carelessness, untrained judgment, and not wearing personal protective gears would be reduced. Also, it is positive to hire such qualified workers as it would be led to the improvement of construction quality and safety management consciousness. As the safety health education method, it would be also great to mix the experienced cases, audiovisual education, and mutual discussion.

### **4.2.2 Vitalization of Safety Culture**

It would be needed to establish the promotion measures for improving the workers' safety consciousness such as safety sign, banner, poster, and safety lounge, so the site atmosphere could arouse the safety consciousness as soon as they enter the construction site. The safety culture should be vitalized through active 'safety campaign activity' for inspiring the workers' safety consciousness. Including the safety sign, setting up the restricted areas, and wearing personal protective gears at construction sites, the safety behaviors should be conducted following the safety education and safety training manual at site. For the foreign workers, the translated safety sign, guidebook, and manual should be furnished by considering the site condition, for smooth communication and understanding of safety management.

The safety cautions, hazardous risk factors, and risk indicators at construction sites should be learnt through safety education for newly-hired workers, and the safety contents using picture, photo, and cartoon for easy understanding should be furnished in resting space and work space, so the workers could obtain the understanding of safety and behavioral culture for themselves.

If the accident outline & causes, current damage status, and concrete cases are actively used for the contents of safety campaign, the greater effects could be expected.

## **4.3 Checking**

### **4.3.1 Strengthening the Safety Facilities**

A lot of accidents are caused when the safety facilities including the 'overturn prevention facilities' and 'work foothold' at construction sites are poorly installed, or when performing a follow-up work after the workers arbitrarily changed/deconstructed the work condition.

As the concrete solution measures, when safely installing the safety facilities by checking if they have been properly installed before starting each process, the disaster accidents would be decreased. The case of arbitrarily changing or deconstructing the safety facilities would be decreasing, which would be naturally led to the decrease of safety accidents.

In case when withdrawing after the relevant work is completed, if the safety facilities that were arbitrarily changed or deconstructed are restored to the original state, the safety accidents related to safety facilities would be reduced.

### **4.3.2 Strengthening the Execution Status Inspection System**

The main cause for many fire accidents in construction sites is the careless ways of using fire. To minimize

the occurrence of fire by unsafe state and behavior, it would be necessary to strengthen the safety regulations related to hazardous material/fire-handling work. Even though every construction site says that the site manager, safety manager, supervisor, and orderer are checking the site. the actual fire accident investigation verifies that the safety regulations for the prevention of fire were not executed like no residing manager. Thus, in order to prevent such fire accidents, the third party's cross-inspection would be needed, so the workers and manager could obey the rules and regulations related to fire-handling work before/during/after operation. It would be necessary to establish the actual execution status inspection system, so the local government could intensively manage and periodically inspect the major hazardous work for the prevention of fire accidents at construction sites.

#### **4.4 Manager's Review & Improvement**

##### **4.4.1 Expansion of Risk Assessment**

The Ministry of Employment and Labor specifies that "The subject of management is the general manager of the relevant workplace and business owner, and the health & safety managers of the workplace would assist, guide, and advise the execution of risk assessment". However, in case of small/medium construction sites with no obligation to appoint a safety manager, it is tough to arrange a safety management staff in charge of the relevant work. And the general manager with great work pressure has the low perception of risk assessment, which is led to the occurrence of problems.

As the concrete solution measures, it would be necessary to strengthen the risk assessment system, to make the general manager perceive the importance and value of risk assessment, and to induce the workers to actively and voluntarily participate in it.

The 'risk assessment collective education' should be obliged focusing on small/medium construction sites without the risk assessment performance system targeting their general managers.

Also, to raise the general managers' will to participate, it would be needed to actively use the 'risk assessment recognition examination' by Korea Occupational Safety & Health Agency, and also to improve such unsafe situations through the risk assessment, which could reduce the occurrence rate of disaster accidents.

##### **4.4.2 CEO's Safety Management**

As a cause for safety accidents by "poor safety education" and "absence of a supervisor", the "CEO's lack of safety will" could be pointed out. The absence of management & labor costs for safety manager is led to the occurrence of accidents. To secure the safety work system in the level of headquarters, the site support & safety organization should be composed.

In other words, as the main variable raising the reduction of accidents in small/medium construction sites, the differences in the perception of safety between employer and management have huge effects on workers' behavior, so the managers' continuous safety will is important.

As the concrete solution measures, it would be necessary to improve CEO's safety management mindset by developing a safety guidance education program for CEOs, and creating the safety education grade system to be completed.

By strengthening the completion of the safety education grade system for CEOs, their ability to understand the problems with site safety would be improved, which would have positive effects on the business performance. If a safety organization is composed, arranged, and supplied in the small/medium construction sites, the accident factors caused by the absence of safety management would be decreasing.

## 5. Conclusions

The objective and significance of this study are to examine the reduction of safety accidents by subdividing the disaster accidents at construction sites through the case analysis method by applying the PDCA theory. The results of this study based on PDCA theory are as follows. First, there should be the measures for writing the safety management plan, executing it in site, and checking the degree of execution by the site manager. Second, by strengthening the arrangement of safety supervisor and performing the accident preventive technical guidance, the risk factors at site should be understood through safety management. Third, it would be needed to reduce the accidents, and also to improve the safety management at construction sites by obligating the permanent arrangement of safety supervisor before starting the construction. Regarding the supervision of construction, electricity, and firefighting, there are clear standards of target construction and work performance while the safety supervision is independently applied by considering the site characteristics or necessity of safety management. Lastly, it would be necessary to prevent the accidents by hazardous work and to manage the career record of skilled workers by operating/arranging the skilled worker grade system at construction sites.

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