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A Methodology for Establishment of Safety Culture in Industry through Global Company Practices

Beom Soo Kim, Yujeong Lee, Seong Rok Chang

Department of Safety Engineering, Pukyong National University, Busan, 48513

Corresponding Author
Seong Rok Chang
Department of Safety Engineering, Pukyong National University, Busan, 48513
Mobile : +82-10-2808-6468
Email : srchang@pknu.ac.kr

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Objective: The purpose of this study is to suggest the methodology for establishment of safety culture in industry.

Background: There have been studies indicating positive relation between safety culture and safety performance. But the areas of those efforts have been mainly focused on elements or factors consisting of safety culture. So it is expected that studies on methodologies for developing process of the culture could contribute for the industry to understand and apply it accordingly in order to improve their practices.

Method: In this study, the scope was considered just for industry, even though there are many fields of culture. As the first step, the limitations of regulatory control and efforts by industry were reviewed, and the trends of researches were presented. In the second step, the global company practices were provided with detailed activities.

Results: This paper showed the limitations of present state in government strategies and industry for safety culture improvement. Also the restricted areas in researches were shown. As one of the solutions to resolve those things, such global company practices as perception to safety journey, the steps of culture development, total safety philosophy, structure and elements of safety process, standards and procedures, training, and up to keys to success were suggested.

Conclusion: Through this study, the development of the structure of safety process which consists of many purposeful activities has been derived to be very important. Because it will be the seeds of safety culture expressing their thinking process and behaviors. Also it is required to approach success step by step according to the achievement of each step.

Application: This study can be used to develop the methodology and safety process in industry with different viewpoints for safety culture establishment.

Keywords: Safety culture, Safety climate, Safety management, Safety performance

1. Introduction

How are the cultures of a country, a region and a home created? In safety, the mechanism of cultural creation and development should be understood first before the cultural level issue is discussed. Because it takes a long time to change a culture formed over a long period of time, it is the most important to establish a proper direction from the start.

Since the term of safety culture was used in a report of IAEA (International Atomic Energy Agency) on the Chernobyl Nuclear Power Plant accident in 1986 for the first time, it has been widely used in all areas including industry. As the importance of safety culture emerges again due to the Sewol Ferry sinking accident, it appears as a core topic in curing safety ignorance (Yang, 2014). The definitions of safety culture are slightly different in various areas such as nuclear power, aviation and railway, according to their characteristics. In the industrial safety area, the KOSHA (Korea Occupational Safety and Health Agency) defines safety culture as "The state in which consciousness and practices are embedded as safety in personal life or organizational activities through the value of safety first being filled in individuals or organizational members, and as an indication of overall meaning including all behavioral patterns, the way of thinking and attitudes for concrete realization of human dignity and values" (Lee and Park, 2011).

Since the end of the 20th century, various researches and applications on the elements, affecting factors and evaluation methods have been conducted in the academia and industry. As a result, it was proved that safety culture and safety performance are closely related (Clarke, 2010; Griffin and Neal, 2000; Hofmann and Stetzer, 1996; Neal and Griffin, 2006), and the main cause of large scale accidents including Chernobyl disaster was presented as the lack of safety culture (Cox and Flin, 1998; Mearns and Flin, 1998; Pidgeon, 1998; Vaughan, 1996). Based on the importance of safety culture, the enhancement of corporate competitiveness is recently addressed highly through linkage of safety performance and management strategies.

Despite lots of efforts as such, the researches and applications of specific mechanisms on the creation and development of safety culture lack a lot. Although Korean industry's accident rate continuously decreases in terms of indicators, it has yet to arrive to the developed countries' level, and social risks are on the rise, as complexity increases according to social development (KOSHA Training Institute, 2012). Meanwhile, government-led regulatory-focused management has limitations in light of the speed to prevent safety accidents through regulatory legislations on the generation of new harmful risk factors, as well as from the management aspect (Moon, 2013). Korean industry also propels various activities to establish safety culture on the basis of past experiences; however, more systematic establishment method is needed for continuous development.

This study presented the methodology for establishment of safety culture in industry that can be applied to industry through global company practices as a solution.

2. Present State of Safety Culture

Even though extensive network is required to establish and diffuse safety culture, this study addressed only autonomous safety culture settlement in the industry. This study introduced perception, philosophy, elements, establishment method and keys to success on safety culture through global company practices, after reviewing the activities of the government and industry and research trends.

2.1 Government's efforts to improve safety culture

The government estimates various risk levels using a mechanism of regulation, and sets forth required standards or executes policies. The Cabinet Council has made efforts to settle and diffuse safety culture from 1995 starting with the people's safety and health culture promotion campaign so far. However, the government did not achieve as they expected (KOSHA Training Institute, 2012).

What effects do the consolidation or ease of regulations have on accident rate? The consolidation of regulations gives burdens to companies, and the ease of regulations has a negative correlation with accident rate (Kim, 2000). If many regulations are not reasonably integrated and coordinated, and division of duties among ministries is obscure, they become obstacles as well. The

large scale accidents so far reveal that safety management level has limitations with just government's regulations. In view of the characteristics of laws and regulations, they have limitations to promptly and flexibly cope with complex and diversified workplaces' harmful risk factors, or specifically apply them to a variety of industries (KOSHA Training Institute, 2012).

In this regard, KOSHA says that the following are required to be reconstituted through researches on developed countries' health and safety culture campaigns: promotion of autonomous activities by industry and government's financial and institutional support, active PR activities for people through mass media, forming cooperative network with associations and private organizations, and the consolidation of entrepreneurs' efforts and workers' autonomous and subjective role in the legislation and regulation sector (KOSHA Training Institute, 2012). Because primary responsibility on the national security is burdened by the government, it is natural to directly regulate safety. However, there is a need to take a notice of global trend that government's role is gradually reduced, and that regulations are turning into corporate self-control.

2.2 Efforts of Korean industry's safety culture establishment

Although broad social consensus is formed in the industry regarding the importance of safety culture, the method to create, settle and develop safety culture is fragmentary, and systematic attributes lack. A model considering major items consisting of safety culture is built, safety culture affecting factors are identified, and various efforts associated with business strategies are made in high risk industries including nuclear power, public transportation and petrochemical industries (Lee and Shin, 2012). In the steel industry, POSCO set business strategy, organizational culture, CEO's safety management philosophy, safety communication and safety educational system as the elements of safety culture, and accomplished by developing PSRS (POSCO Safety Rating System) for the first time in the Korean manufacturing industry, selecting ten commandments for safety leadership and reorganizing and expanding the safety organization (Moon, 2013). In the construction industry, SK Engineering & Construction analyzed factors affecting safety culture, established the code of conduct consisting of 20 items, set forth five safety culture elements, and established 12 types of safety culture (Choi and Ko, 2015).

Although such efforts have achieved some outcomes to some degree, there are limitations in activities, and a concern on achievement creation and sustainability due to the following reasons:

- Passive activities by independent event or program-centered external players
- Event-focused promotion including campaign, sign board and safety inspection day
- Improvement methods according to results due to level measurement are fragmentary, repetitive, and therefore a process approach lacks.
- Effect or efficiency lacks, because the intent of each activity is not clear, or because of duplicity of activities.

2.3 Trend in safety culture researches

Concerning the researches on safety culture overseas, the concept, definition, scope, perspective and classification are different by country, theme and subject as shown in Table 1, but each element's interactions or impacts are almost similar (Lee and Shin, 2012). In Korea, researches have been focused on the identification of individual consciousness and attitude change based on safety culture elements, comparison of foreign countries' safety culture practices, and factors affecting safety culture including safety culture activation methods through fact-finding survey as shown in the references (Lee and Park, 2011). Consequently, researches on the process establishing safety culture or systematic approaches are enormously insufficient domestically and internationally. One of the characteristics of safety culture is diversity and complexity, and there can be some irrationality to approach with a simple concept, and inefficiency and confusion can be caused, due to remarkably different approaches and efforts according to perspective (Lee, 2015). However, more help to industry is considered to be offered, if selectivity is enhanced through various practices studies.

Table 1. Researches of safety culture in abroad

Author	Year	Themes/Results
Zohar	1980	8 elements which constitute safety culture in organization.
Brown and Holmes Dedobbeleer & Beland Coyle et al.	1986 1991 1995	Safety culture constitutes around 10 configuration variables.
Berends	1995	Developed the first safety culture model.
Flin, Mearns, O'connor	1998	Developed the questionnaire of safety climate.
Neal et al.	2000	Positive correlation between safety culture and safety behavior.
Cooper	2000	Psychological, behavioral and environmental perspective in safety culture
Geller	2001	Offered new 3E (Empowerment, Ergonomics, Evaluation)
Mohamed	2002	10 positive factors in construction industry related to sense of safety.
Von Thaden et al.	2006	Verified individual issues in organization affect to safety culture.
Neal & Griffin	2006	Studied correlation between safety climate and incident rate
Guldenmund	2007	Showed 9 items which are related to organizational strategies.
Mylett	2009	Suggested systematic approach based on risk assessment.

3. Practices of Global Company for Establishment of Safety Culture

This study researched a safety culture establishment practices of an A Company, which grew into a global company in industrial special gases with 10 billion USD in annual sales with some 20,000 for 75 years, since its foundation in the U.S. in 1941. This study analyzed the factors that become the true nature of safety culture on how they were applied with what concept under what purpose, beyond simple definition of safety culture elements or affecting factors. Namely, this study confirmed vision looking at safety culture, perception of creation step, philosophy on safety accumulated through long history, and how safety process affecting employees' consciousness and behaviors was designed and improved. This study also included the operation of standards and procedures governing all activities, training to learn all these, and required keys to success in order to achieve all these.

3.1 Perception on safety culture approach

There are many cases in which safety culture is pointed out as an alternative without presenting a specific model like a panacea upon safety problem occurrence. This is regarded as overlooking the fact that various management techniques can be suggested according to the type or maturity of safety culture.

A Company named the process to reach mature safety culture safety journey as shown in Figure 1, and it understands in association with recordable rate (accident rate) based on its own statistical data by dividing the journey into five steps (Recordable Rate=1 is the level of one injury accident annually based on 100 people). In other words, all steps - Compliance, 3E, Structure, Behavior, People (Culture) - should be achieved to reach ultimate safety culture level, since there are limitations in achievement that can reach by step. The horizontal axis is the measure of safety culture level, but levels of various activities are presented in sub-area by step, and the direction for organization members to head is presented convincingly in linkage with A Company's own safety performance. Concerning safety problem, the achievement strategy by level is established, focused on each step's elements according to evaluation result.

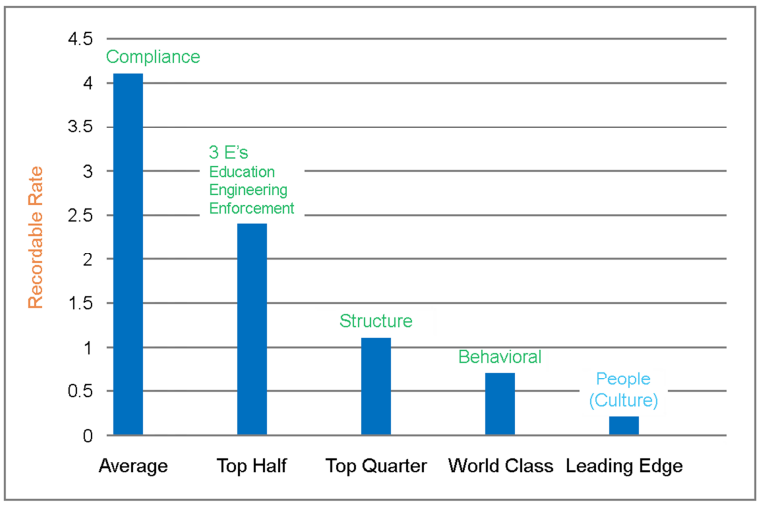

Figure 1. Safety journey of A Company

3.2 Safety culture development step

As shown in the definition of safety culture, culture is expressed with consciousness and behavior. Reversely speaking, culture can be successfully established, if the consciousness and behavior are continuously developed. A Company promotes the growth of consciousness by putting priority behavior over consciousness.

As revealed in Figure 2, plan specific activities becoming the elements of culture. For example, make various activities having intents such as field inspection, safety observation, safety meeting, safety contacts, and emergency drills by linking them organically a process, allocate them according to individual position and role, and make an execution plan annually. And then, repeatedly execute them, and make the members attain proficiency, and those can be habitual. As the results consistent with each activity's intent are created, the members perceive values. These values are accumulated and gathered for a long time, and place themselves

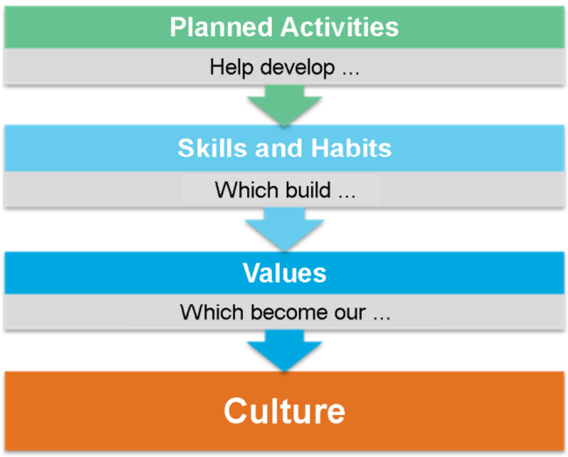

Figure 2. Steps of culture development

as organizational culture. The activities executed as an obligation at first place themselves as an organization's unique culture, as the members perceive the need and values. A Company defines culture as "It's the way we do things around here".

3.3 Total safety philosophy

Although most companies declare environmental health and safety policy and cardinal rule, not many companies use the term of philosophy. A Company's first philosophy is "All accidents and injuries are preventable". What is important is whether the employees believe in the phrase. If they do not believe 100%, they will not make an effort to prevent accidents any more from the moment that they do not believe.

Then, how the company should make the employees believe the phrase. Let them regard that accidents are caused, not just occur. Namely, the accident prevention possibility is to judge with a root cause control possibility. This is valid logic from the aspect that one or more of most root causes can be controlled. However, an example of carefulness lasting time is explained with a question, **"**How even one employee out of thousands of employees won't be injured?**"** If one is safe now, the person can be safe for the next few minutes, and if concentration continues, the person can be safe for an hour, a day, a month, a year and several years.

3.4 Development and evolvement of safety process

A Company developed the safety process after 30 years since its foundation in 1941, and it has been evolved for about 45 years. The company upgraded the safety process with a cycle of about ten years, and I was much impressed as I watched the overall process in 2013. About three years has been inputted. For the first year, the company executed internal audit and benchmarking, and established an improvement direction during the next one year, and then offered training for the trainers for a week by gathering one or two trainers in the world, where A company's workplaces belonged, in the U.S. headquarters in the third year. And then, the trainers trained all employees in each country. Only qualified trainers trained the employees with less than 25 trainees per class. It's because the intent of the process design could be biased during the 2nd delivery of the training. It shows that they regards the intent as very important upon the safety activities or process development and the search for efficiency by not disturbing each activity's organic relations through careful approach in the case of intent change.

In this way, the process is established as company's optimized and unique safety process over a long period of time, and becomes a factor of culture naturally. Upon safety problem occurrence, the review and improvement of the process are conducted in priority, rather than through one-off event. Such an act is worthy of taking notice in light of Korean situation in which such a process was not developed, centered on temporary activity.

3.5 Safety process elements

Although core seven categories of International Nuclear Safety and Security Commission's INSAG-15 are presented typically as a strategic approach for safety culture establishment (KOSHA Training Institute, 2012), this study arranged six categories except contractor safety out of A Company's seven categories such as leadership, safety accountability, build and maintain safe work conditions, build and maintain safe work behaviors, emergency preparedness, process evaluation and improvement. These categories consist of various activities, and are autonomously operated within the safety process frame with mutual association, as well as with individual intent.

Recent process design is on how much safety activities are connected with duty activities, and leaders are instructed to focus on coaching and auditing, and the team members are directed to focus on onsite danger elimination activities.

Leadership

Leadership is mentioned as the core of safety culture establishment in many previous studies. The association between leadership and other activities, however, lacks in concreteness. A Company includes it in the safety process. First, how greatly a leader can have a positive influence on organizational culture is emphasized. Second, management leadership role is made clearly. Third, company's organizational hierarchy is reorganized as the safety organization, and the activities of team leaders and team members are specified, and thus leadership can exert within each one's role in all hierarchies. Namely, each member can participate without exception by organizing the safety organization in which all employees participate, not limiting a leader to a specific group.

Safety accountability

Who will be responsible for safety? This is about the division of roles on safety activities within an organization, and responsibility. A Company discerns responsibility from accountability. Responsibility is the role allocated to a person, and accountability is regarded as an obligation to conduct any given duty. This means the importance of awarding safety activities to each one, and practicing them. To this end, A Company documents the role and responsibility of each activity, and specifically presents them by making an RACI (Responsibility, Accountability, Consult and Information) chart. The reason is that responsibility of all cannot be anyone's responsibility.

Then, why the responsibility of safety activity should be accepted? A Company puts the highest priority on moral reason, among three reasons: moral, legal and economic reasons. In other words, it is taken for granted, because not hurting me and my colleagues is the right thing. Cases in which employees demand return for safety activity around us can be easily encountered. Therefore an organization's level can be weighed up even with the reason why safety activity should be conducted.

Build and maintain safe work conditions

This is about a problem on the drawing of unsafe state. As KOSHA mentions seeing danger is the start for safety, finding potential dangerous state is very important. A Company has two key points upon field inspection. Firstly, finding all dangers. The reason is that an accident may occur, due to remaining dangers, if all dangers are not found. Secondly, letting anyone find dangers at the same level. Because an ability to find a danger is different according to experience and common sense, there can be omission of dangers according to inspector.

A Company applies two methods: First, the development of check list specialized by team and workplace. If a new danger is identified, it is added to the check list. In doing so, if anyone uses the check list, the person can figure all things out. Also, as a leader inspects the same path with the inspector once again, it can be regarded as a coaching opportunity. Second, unsafe state is perceived as the result of unsafe behaviors. The behaviors that made unsafe state are ascertained, and fundamental solutions are attempted not to repeat the same behaviors. Good inspection activity is to identify a danger, let others know about it, and teach it. Once the danger is identified, people are careful about the danger.

Build and maintain safe work behaviors

Why do people unsafely work taking a risk? There can be many reasons such as "did not know" and "busy", and people select one of them. A Company is focused on how to deal with such reasons. Perfect standards and procedures cannot be made to cope with all situations, since various activities exist in workplaces. For people to properly behave, they need to be equipped with mental skills. For example, what is needed for a person who wants to be a good baseball player (hitter)? Firstly, practicing a lot alone. Secondly, the person needs to practice more through concentration by identifying ball quality thrown to the person. Third, the person needs a coach who can help him. Developing safe behaviors is based on such a principle. A team member conducts given activities repeatedly, and a team leader offers coaching continuously to enhance efficiency.

Let's take an example of "job safety analysis", which is applied by many companies recently. The primary purpose of such an

activity is to find and control job-related dangers, and find optimum work method. Meanwhile, the purpose is to foster team member's job analysis capability by a leader, and let the team member think so, and make such an activity a habit. The execution player, subject, frequency and achievement demand level become different according to how people perceive such a purpose.

Emergency preparedness

Most of 2,700 Morgan Stanley employees on the 44th floor of the No. 2 and 5 towers were safely evacuated upon the terror attack to the World Trade Center in September 2001. When the No. 1 tower was attacked, they started evacuation by walking from the 44th floor of other towers. How did such a situation occur? They were planned to do so, practiced as planned at the usual time, and they conducted what they practiced, when a situation occurred. The drill types being conducted by A Company are shown in Table 2.

Table 2. Emergency response exercises/drills

Title	Description	Frequency	Practitioner
"What-If" exercise	Present a scenario and have participants talk about their responses.	2 months	Team
Emergency skills drill	Practice an emergency response task		
Table top exercise	Review steps to be taken in the event of an emergency	1 year	Site/Plant
Full scale functional exercise	Present an emergency event and have participants walk through the steps they would take		

A Company's intent of emergency response drills is not only reacting to unexpected situation reactively, but taking a necessary action proactively by expecting situation progress. The basics of emergency drills is not just drills to show externally, but is in each team's small scale drill, and all situations that may occur in the team are listed, and the proficiency of capability and behaviors to cope with is promoted through virtual exercises and practical drills. In the case of emergency beyond a workplace, it is defined as a crisis, and crisis management is operated in association with a separate global team, and such a crisis is responded according to pre-established work process. This is also exercised at the usual time.

Process evaluation and improvement

This theme is the activity being conducted actively in Korean companies, and various methods are used. However, there is a need to examine whether evaluation players and results are reflected autonomously, and whether the evaluation methods are duplicated or omitted for the purpose. In A Company, the evaluation is an activity required much upon safety process designing as leadership activity. The evaluation intent is not to call team members to account, but help effective activities, and it is to check and guide team member's individual activity, and make it an opportunity to share with other team members. An upper hierarchy leader conducts the same activities towards the lower hierarchy leaders.

In A Company, various check lists for evaluation and inspection have been developed, and are executed by line management in the organization mostly, the results and improvement proposals are reviewed and decision making is made within the team. The health and safety team conducts monitoring and evaluation of overall activities, and provides necessary guides and check lists. The activity executor explains the evaluation result in the safety meeting, and carries out an integrated analysis cyclically. Safety journey assessment is operated as an evaluation method measuring workplace's safety culture level. This tool was developed by global EHS senior group over two years, and the health and safety team conducts the assessment on five themes with 53 questions. The corporate audit by experts is carried out in every 5~10 years according to workplace risk level, and the result is tracked and managed systematically.

3.6 Standards and procedures

The answer to a question that how A Company effectively manages workplaces scattered in so many places is 'standards and procedures'. Although most companies have their own standards and procedures, there will be much difference in accuracy and utilization of the standards procedures. Such a difference seems to be derived from a topic that how to make employees know so many standards and procedures. A Company also operates many standards and procedures by function such as field safety, process safety and product safety. All standards and procedures are the subjects of MOC (management of change), and they are supposed to be disposed after using them through downloading from website in order to prevent errors by using old versions. If standards and procedures collide with Korean laws, stronger requirements are applied in principle, and the country level (Tier 2) or site level (Tier 3) standards and procedures are developed by local team as sub-standards and procedures. What needs to note is that A Company has a process in which training materials connected to the standard and procedure are made for employees' familiarization, and the materials are modified upon the change of standards and procedures. In other words, employees are familiarized with the important matters by training first, and then they use the standards and procedures on the more specific matters. In this way, A Company has two-step approach.

3.7 Training

The training on safety culture plays a key role. Therefore, training hours, instructor's qualification and training contents are specified in laws and regulations, but there is a limitation to reflect peculiarities of each industry and company. In this regard, industrial or corporate own training management system is additionally required. A Company is focused on program organization and training materials development suitable for its employees and training completion status through on/offline training. The company organizes the employees into seven job groups, and applies training programs according to the job characteristics in a package manner, and the programs are modified upon department transfer or job change. As for training materials, the additional materials are utilized on the basis of official materials awarded with the qualification number. The training excluding basic training materials is not allowed. Training completion status is checked by team leaders in the monthly safety meeting. Total training hours are not set forth, but A Company is focused on organizing programs suitable for jobs. The reason is that what knowledge should be delivered is regarded as more important than training hours.

3.8 Keys to success

A key to success lies on how successfully organization's safety process is established, because the process consists of organic connection of various safety activities, and the process is revealed as culture through consciousness and behaviors. Towards this end, A Company stresses the following three points:

Firstly, application of all basic elements – Execute all.
A safety process consists of various elements, and they have mutual correlations under respective intent. Like human's function cannot be perfect with just part of human body, all the items of the elements need to be executed.

Secondly, continuous interest – Always implement.
What is the reason why an accident occurs, despite very good period of safety performance? Is it correct to emphasize safety only when safety performance is not good? It is actually important to apply the process all the time, regardless safety performance.

Thirdly, full participation – All employees need to participate.
Can my colleague be hurt because of me? Or can I be hurt due to my colleague? Therefore all need to participate in safety activities without exception.

4. Conclusions and Discussion

This study examined government-led regulation-focused strategies for safety culture establishment, industry's autonomous activities and research trend in the academia. As a result, some achievements have been attained, however, this study confirmed that there are some limitations to establish safety culture at the expected level. As a method to solve such limitations, this study presented core details through global company's safety culture establishment practices such as perception of safety culture, approach, safety philosophy, process development and evolvement, elements, standards and procedures, training and keys to success Above all, it is important to define substantial activities of safety culture, link them organically, and constitute a processed structure. And then, if the applicability and effects of the process are consolidated like net's fineness and solidity, the company's autonomous and unique culture will grow as time goes on, and excellent safety performance will be revealed as an outcome.

There will be some difficulties to comprehensively apply one company's practices to entire industry. However, overall structure can be drawn from the safety culture, and it is expected to contribute to direction establishment through comparison by the mentioned players. More various advanced companies' practices need to be researched in the future so that Korean industry's selectivity and applicability can be enhanced. To this end, if the integration and arrangement of various previous studies are conducted, it can be utilized for further study's direction establishment more efficiently.

References

Choi, D.S. and Ko, Y.W., Case Study of Safety and Health in Construction, *Journal of Building Construction*, 15(1), 19-29, 2015.

Clarke, S., An Integrative Model of Safety Climate: Linking Psychological Climate and Work Attitudes to Individual Safety Outcomes Using Meta-Analysis. *Journal of Occupational and Organizational Psychology*, 83, 553-578, 2010.

Cox, S. and Flin, R., Safety Culture: Philosopher's Stone or Man of Straw. *Work and Stress*, 12, 189-201, 1998.

Griffin, M.A. and Neal, A., Perceptions of Safety at Work: A Framework for Linking Safety Climate to Safety Performance, Knowledge and Motivation, *Journal of Occupational Health Psychology*, 5, 347-358, 2000.

Hofmann, D.A. and Stetzer, A., A Cross-level Investigation of Factors Influencing Unsafe Behaviors and Accidents, *Personnel Psychology*, 49, 307-339, 1996.

Kim, C.O., Governmental Safety Management Policy and Safety Culture Movement, *Hwang-Hae Culture*, *Journal of Saeul Foundation of Culture*, 379-391, 2000.

KOSHA Training Institute, Safety and Health Culture in Industry, 36, 47, 128, 138, 144, 149, 240, 242, 2012.

Lee, J.Y. and Shin, K.R., A Study on Measurement of Safety Consciousness and Safety Culture in organization of Petrochemical industry, *Journal of safety and crisis management*, 8, 65-86, 2012.

Lee, K.H. and Park, H.C., A Study of the influence of the manager safety leadership on workplace safety culture, *Proceedings of Korea Safety Management and Science*, 300-302, 2011.

Lee, Y.H., A Study on the Human Factors Engineering Approach to Safety Culture, *Proceedings of The Ergonomics Society of Korea*, 245-253, 2015.

Mearns, K.J. and Flin, R., Assessing the State of Organizational Safety - Culture or Climate?, *Current Psychology: Developmental, Learning, Personality, Social*, 18(1), 5-17, 1998.

Moon, K.S., A Study on the Organizational Safety Culture and Safety leadership: POSCO case, *Journal of Business History*, Korean Academy of Business Historians, 28, 25-28, 2013.

Neal, A. and Griffin, M.A., A Study of the lagged Relationships among Safety Climate, Safety Motivation, Safety Behavior, and Accidents at the Individual and Group Levels, *Journal of Applied Psychology*, 91, 946-953, 2006.

Pidgeon, N., Safety Culture: Key Theoretical Issues, *Work & Stress*, 12, 202-216, 1998.

Vaughan, D., *The Challenger Launch Decision: Risky Technology, Culture, and Deviance at NASA*. Chicago: University of Chicago Press, 1996.

Yang, H.S., Awareness of Behavioral Based Safety for Safety Culture Establishment, *Journal of Industrial Health and Safety*, of Federation of Korean Trade Unions, 32-33, 2014.

Author listings

Beom Soo Kim: kbswillbe@naver.com
Highest degree: Master, Department of Safety Engineering, Pukyong National University
Position title: EH&S manager, Air Products Korea
Areas of interest: Field study of safety engineering, Safety culture, Safety Management System, Incident Reporting

Yujeong Lee: yj_lee@pknu.ac.kr
Highest degree: PH.D., Department of Safety Engineering, Pukyong National University
Position title: Lecturer, Department of Safety Engineering, Pukyong National University
Areas of interest: Aging, Aesthetic Engineering, Work ability, Musculoskeletal disorders, Job Stress

Seong Rok Chang: srchang@pknu.ac.kr
Highest degree: PH.D., Department of Industrial Engineering, Seoul National University
Position title: Professor, Department of Safety Engineering, Pukyong National University
Areas of interest: Work Physiology, Musculoskeletal disorders, Work ability, Job Stress, Digital Human Modeling, Human Error Reduction, Risk Management, Safety Management System