A Methodological Study on the Development of a Categorization System for Safety Standards

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Abstract

The government have several ministries, and each have the right making regulations related to oneself works and duties. The relevant ministries decide the enactment of regulation and statutes related to safety and maintenance of facilities and substances. To do that, even if the same facilities or materials, overlapping safety standards depending on the purpose of each departmental are being made in different. Manager or owner, operators all work to be performed according to different safety criteria, double tesk and inefficiency of business are recognized as a problem. Accordingly, in this study, in order to minimize the enactment of these overlapping laws and regulations and to prevent the safety accidents, the methodology of development of classification system related to safety standard in law having the government departments is studied. This allows blocking fundamentally the creation of similar law related to the same facilities and materials considering the purpose and provisions of the applicable safety standards. Futher making DB system development based on the classification can be help to recheck the preventive function related to the law to all ministries

1. Background and Significance of Study

Recently, safety accidents are on the rise in Korea. Thus, significant numbers of casualties and property damages are being incurred. Numerous laws and regulations are being drafted to control and manage the safety accidents occurring from the highly-clustered infrastructure of Korea and the continuous increase of the number of facilities. However, because the entities in charge of each type of safety standard are different from each other, though the objects of regulation may be the same, depending on the purpose of the regulation, the definitions and scopes of safety standards differ from each other when it comes to individual laws. Consequently, users and supervisors alike who are actually to observe those regulations are not clearly aware of the regulations on safety standards.

General safety management standards are often regulated by individual laws. However, the majority of other safety standards (specific management standards, facility standards, inspection and monitoring standards, and other technical standards) are being comprehensively defined in the enforcement regulations of the individual laws. Specific safety standards are also regulated by administrative rules such as notifications and orders; such rules are legal systems subordinate to the individual laws. To make matters worse, the coordination system between government departments is one of mere formality although it had been introduced to minimize the difference of safety standards between individual laws. In reality, each department is enacting and executing its own set of safety standards independent of the other departments.

Especially, the Korean legal system for safety management does not center on objects (targets which run high risks for accidents) but rather focuses on individual elements related to those objects, such as equipment, facilities, electricity, gas, boilers, elevators, and materials. Consequently, as a system, the Korean legal system is far lacking in terms of preventing safety accidents.

In particular, legislation on safety management and related matters are not being managed with a unity. Rather, the different laws on individual facilities and materials are being enacted independent of each other. Thus, managers and users alike are both in need of an organized ordering and management of safety standards.

In the Korean legal system, different departments are designated to manage either facilities or materials. When it comes to unity and professionalism, each department is power by ordinance to determine its own safety standard with subordinate legislation such as notifications or orders. However, though two different departments may be regulating the same facility or material, the legal system is set so that the departments may set up safety standards different from each other depending on their purpose behind safety management. Thus, users and operators have to comply with differing standards on the same facility/material. They find it difficult when deciding on which standard to comply with when it comes to approval and permission. This leads to wastes both in time and cost. Furthermore, such a system is also an obstacle for efficient safety management.

Korea has experienced phenomenal growth in its industry and technology. But the awareness of safety standards and coping mechanisms for accidents has been neglected in the name of cutting costs. Recently, a large-scale accident from toxic chemicals and the high risk that the chemicals will leak to the surrounding environment is one case that well shows the increasing risk levels in Korea in spite of its rapid industrial growth. Korean legislation on chemical materials includes the following: *Toxic Chemicals Control Act*, *Framework Act on the Management of Disasters and Safety*, *Industrial Safety and Health Act*, *Framework Act on Fire Services*, and *High-Pressure Gas Safety Control Act*. Despite the relatively high levels of interest on toxic chemicals, the lack of a system to systematically manage the different laws and the insufficiency of safety management all lead to same types of accidents occurring repeatedly.

Countries such as the U.S. or EU nations which have advanced safety standard systems have all continuously put effort into creating a unified system for their different safety standards. Though the departments-in-charge and legislative systems may differ for given facilities and materials, the system is set so that the systematized safety standards have to be observed by all departments and laws.

The purposes of this study are as follows: 1) inspect various safety accidents and analyze the safety standards of related legislation and regulations that are currently being applied to such accidents 2) solve legal confusion and redundancies/differences of safety standards, and 3) create a categorization system which systematizes safety standards so that disaster managers, safety-related administrators, and facility operators may examine and utilize safety management measures in a comprehensive and systematic manner.

2. Method of Study

A. Creation of a categorization system for different safety standard categories

○ Since the objects for safety standards are wide in scope and since there is difficulty in categorizing the many different safety standards, there is need to establish principles and objectives for the categorization. Thus, the following six principles have been established as the categorization principles for a categorization system: diversity, exclusivity, sizeability, similarity, universality, and applicability.

- Diversity: includes all legislation and administrative rules of all departments that are related to safety accidents which are either occurring or run the risk of occurring around people's lives
- Exclusiveness: Each field in the categorization system is to be as independent of each other as possible and distinguishable from one another.
- Sizeability: Even if two categories are similar to each other, if they are in-depth or have considerable significance, they are to be treated as separate categories whenever possible.
- Similarity: Items under the same mother category share similar characteristics.
- Universality: Anyone is to easily understand, accept, and access the categorization system.
- Accessibility: The categorization system should be linkable and accessible by safety standard categorization systems in other fields.

○ During the development of the categorization system for safety standards, the *Framework Act on the Management of Disasters and Safety* was partially revised. To reflect such revision, the categorization system under development was reconfigured by observing the six principles mentioned above.

B. Setting the criteria for the scope of categorization system

○ To set up a categorization system for safety standards, existing studies and related safety issues were considered to conduct an examination of categorization. When examining existing research studies, the *National Emergency Management Plan* and "A Study on a Categorization System for Safety Accidents as an Aspect of Disaster Prevention Safety Engineering" were examined. The two studies under inquiry had different categorization systems from each other as each was trying to meet societal requirements at the time of its drafting. Thus, both had shortcomings in being selected as a universal standard.

Especially, there was a very significant difference in the areas of categorization for accident causes and facility safety standards. Consequently, there is a need to create a more consistent safety category.

Since the system aimed to comprehensively include all the safety standards of all departments, the major categories were created based on positions/locations people use and move in, rather than focusing on specific places.

Based on precedents and in consideration of the six principles, the safety categories for safety accidents that can occur in living spaces were ordered into eight (8) categories. Areas of national importance were put in a separate category. Specifically, the categories are as follows: facilities (buildings), livelihood/leisure, transport/transport facilities, industrial/construction sites, environment/energy, info/communication, health/foods, and other. Following is the scope of each of the eight categories as introduced by this study.

1. Facilities (buildings)
   - ·Safety in the area of fire and structural/facility maintenance for the following: residential and multi-purpose facilities, educational facilities, facilities for the young and elderly, cultural assets, production of hazardous materials, supply facilities

2. Livelihood/leisure
   - ·Safety issues related to handled equipment, risk equipment, play facilities, and all sorts of outdoor activities pertinent to livelihood or leisure activities
3. Transport/transport facilities
   - ·Facilities related to all types of transport-land, water, and air; safety issues related to safety ancillary facilities, users and operators of transport, and transport vehicles
4. Industrial/construction sites

·Safety issues related to facilities and human errors surrounding all types of construction sites and industrial zones (factory facilities excluded)

5. Environment/energy

·Safety issues related to hazardous materials, facilities, and power plants that pose risk to air, earth, water environments, and humans; also related to facility safety

6. Info/communication

·Safety issues related to safety of info communication and medium; issues related to safety of info/communication facilities and info protection (cyber safety excluded)

7. Health/foods

·Safety issues related to medical and infection (contagion) matters; issues related to safety of facilities for health/welfare and facilities for hygiene of foods-fishery, meats, and vegetables

8. Other

·All other safety issues not mentioned above

With these eight major categories as the base, other specifics and definitions were set for the categories so that a more detailed categorization could take place. Top-down and bottom-up approaches were employed simultaneously to set up the specifics and definitions.

With the top-down approach, the defined major categories are used as the base to place different objects into sub-categories. The bottom-up approach takes a different approach in that risk levels are taken into consideration. Risk levels are determined by frequencies of safety accidents and number of casualties. Based on risk levels, specific facilities and objects are put together as lists and then grouped together by similarities.

Creating the eight major categories with the top-down approach did not prove much difficult. But going down to sub-categories, it was often the case that specific areas would either be omitted or not found. Thus, the major categories would have to be revised and supplemented again and again. To rectify this issue, the bottom-up approach was employed. Safety accidents occurring in Korea and abroad were surveyed and analyzed, looking at facilities and materials in particular. Then, based on the survey and analysis results, specific items could be found and matched to major categories.

For the bottom-up approach, first, major risk facilities and materials as designated by were examined. Secondly, the NFD2 fire statistics were utilized to analyze the accident details and the different issues related to safety facilities. Third, the safety tasks of each department were examined to look into the similarities of the analyzed items. With the analysis results, items were grouped by characteristics. Finally, three categories were created: tier-three, tier-two, and tier-one.

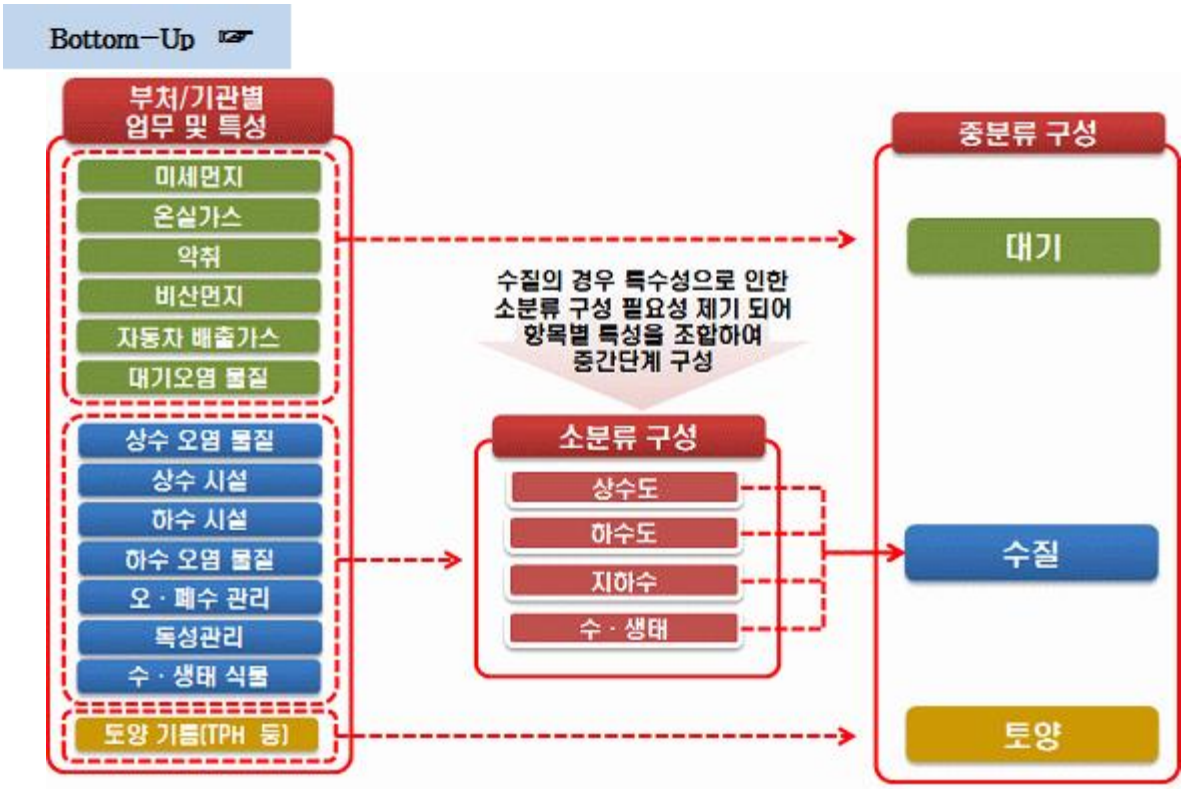


Figure 1) Example of Bottom-Up Method

부처/기관별 업무 및 특성	Department/Agency Tasks and Characteristics	수질의 경우 특수성으로 인한 소분류 구성 필요성 제기 되어 항목별 특성을 조합하여 중간단계 구성	In case of water quality, tier-two grouping was needed; thus, items were grouped by characteristics and the tier-two category was created.	중분류 구성	Tier-one
미세먼지	Fine dust			대기, 수질, 토양	Air, water quality, soil
온실가스	Greenhouse gases				
악취	Foul Odor				
비산먼지	Dust scattering	소분류 구성	Tier-two		
자동차 배출가스	Automobile emission gas	상수도	waterworks		
대기오염 물질	Atmospheric pollutants	하수도	sewage		
상수 오염 물질	waterworks pollutants	지하수	underground water		
상수시설	waterworks facilities	수.생태	Water/ecological		
하수시설	sewage facilities				
하수 오염 물질	sewage pollutants				

오.폐수 관리	Waste water treatment
독성관리	Toxicity treatment
수.생태 식물	Water/ecological plants
토양 기름 (TPH 등)	Soil oil contents (TPH)

The categorization system as created by the bottom-up approach does not differ much with the system created by the top-down approach. However, the bottom-up approach allowed for easier categorization of specific objects when compared with the top-down approach. The following table shows the top-tier, tier-two, and tier-three categories of each safety category, together with the items that are under each respective category.

Table 1) Detailed Categorization System for Facilities (Building) Category

Tier-one	Tier-two	Tier-three
Residential safety	Detached housing	
	Joint housing	
	Other	
Multi-purpose facilities	Sales facilities	department stores
		shopping centers
		discount supermarket
		marketplace (wholesale, retail)
		underground shopping center
		commercial building
	Business facilities	public
		general
	Religious facilities	churches
		cathedrals
		temples
		prayer centers/monasteries
		convents
		shrines
		other
	General service facilities	public hygiene facilities
		commodities sales facilities
		auto-related facilities
		other general services
	Cultural/mass meeting facilities	performance venues
		meeting halls
		theaters
		convention centers
		zoos/botanical gardens
		model houses
	Medical facilities	general hospitals
		mid-size hospitals
		dentists
		oriental medicine hospitals
		psychiatric hospitals
		postnatal care centers
		pharmacies
		nursing homes
		clinics
		funeral parlors
		bone-setters
		midwifery service centers
		acupuncture centers

		oriental medical clinics
		other medical facilities
	Lodging facilities	hotels
		motels
		inns
		hostels (over 1000 ㎡)
		homestays (under 230 ㎡)
		recreational condos
		tourist hotels
		pensions (30 rooms or less)
		other lodging facilities
	Sports facilities	**Indoor sports facilities**
		roller skating rinks
		ice skating rinks
		swimming pools
		indoor fishing
		aerobics
		fitness centers
		weight lifting
		martial arts centers
		table tennis facilities
		indoor baseball parks
		bowling alleys
		billiard halls
		Outdoor sports facilities
		tennis courts
		playgrounds
		shooting ranges
		horse-riding courses
		golf courses/driving ranges
	Recreational facilities	karaoke bars
		bars
		private facilities/game providers
		dance halls/dance studios
		phone rooms/chat rooms
		karaoke rooms
		gaming/entertainment facilities
		internet game facilities providers
		video providers
		multi-distribution game providers
		other recreational facilities
Safety training	Training facilities	livelihood training facilities
		nature training facilities
		other youth facilities
	Institutional facilities	training institutes
		general institutes
		private institutes
		fine arts institutes
		foreign language institutes
		other research/institutes
	School facilities	elementary schools
		middle schools
		high schools
		universities
		special schools
		vocational schools
		other schools

	Correctional/military facilities	**Military facilities**
		barracks
		other military facilities
		Correctional facilities
		prisons/lock-ups
		youth detention centers
		other correctional facilities
	Research facilities	individual research centers
		individual research institutes
Facilities for children, elderly, and socially disadvantaged	Welfare facilities for children	
	Welfare facilities for the disabled	
	Welfare facilities for the homeless	
	Welfare facilities for youth support	
	Welfare facilities for single-parent families	
	Welfare facilities for mental health	
Cultural assets	Cultural assets	designated cultural assets
		non-designated cultural assets
		evidences for cultural assets
Manufacture / supply facilities	Hazardous materials	manufacturers
		storages (use included)
		handling (charge/sales, supply)
	Gas facilities	manufacturers
		storages (use included)
		handling (charge/sales, supply)
	Factories and warehouse facilities	factories
		warehouses

Table 2) Detailed Categorization System for transport/transport facilities

Tier-one	Tier-two	Tier-three
Road transport	Road transport facilities	
	Road transport safety facilities	ancillary facilities/street lamps/banisters
		traffic enforcement equipment
		signal systems/sign posts
	Means of road transport	users/operators
		bicycles
	Pedestrian safety	crossing safety
		alley safety
		interchange safety
Railroad transport	Railroad transport facilities	
	Railroad operation facilities	railroad communication
		railroad electricity
		signal systems, signposts
		other railroad facilities
	Railroad transport safety facilities	
	Means of railroad transport (railroad vehicles)	power driving cars
		passenger cars
		freight cars
		special cars
	Passenger safety	
Air transport	Air transport facilities	

	Air transport safety facilities	
	Means of air transport	
	Air communication safety	
	Passenger safety	
Water transport	Taxiway line safety	water transport facilities
		water transport safety facilities
		means of water transport
	Ship safety inspection	ship safety
		shipment safety
	Port facilities safety	
	Maritime affairs safety	safety diagnosis of water transport
		handling of navigation obstacles
		safety management for navigation
	Safety from water pollution	prevention of ship pollution
		prevention of pollution from marine facilities
	Sea surroundings safety	collection, storage, and handling of pollutants
	Passenger safety	passengers safety
		operators safety
Transport safety training	Road transport safety	
	Air transport safety	
	Water transport safety	
	Railroad transport safety	

C. Public hearing and survey with expert panel for safety standard categorization system

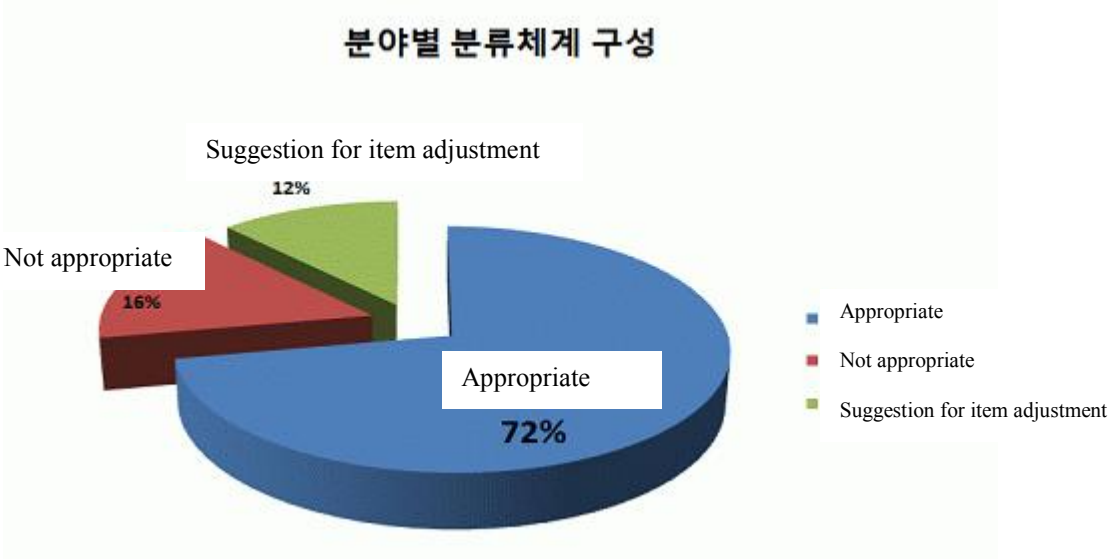
○ For the validity checking of the eight major categories as selected by this study, a public hearing was held with an expert panel. In addition, surveys were administered to the panel.

○ Survey questions are as follows:

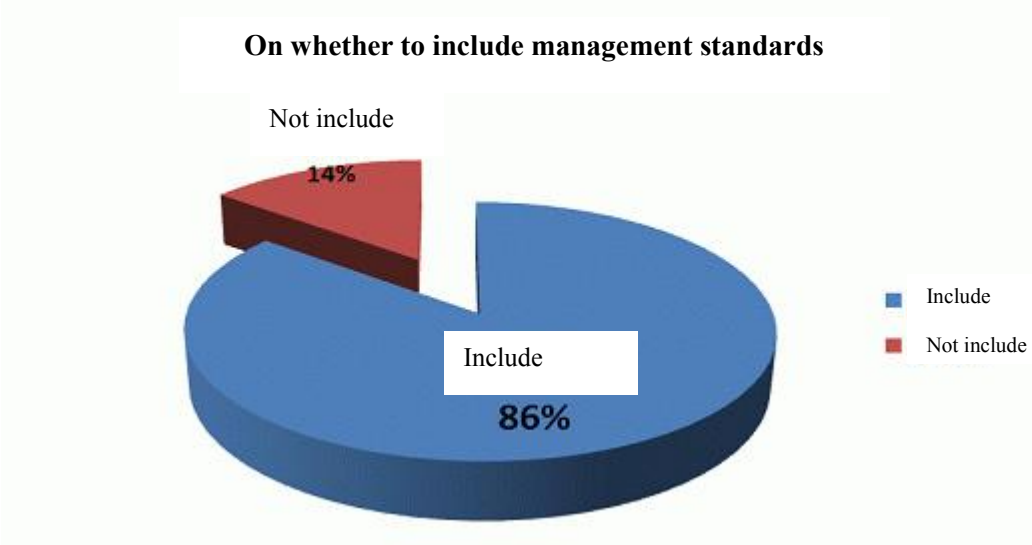
- Is it appropriate to categorize all legal provisions of all departments into eight major categories of the categorization system under inquiry?
- If there is a category that should be added (or has been omitted), what is it?
- When making safety standards into databases, numerous laws and regulations exist for prevention of safety accidents. Is there a need to manage the management standards of those provisions (for ex.: inspection, approval, training) by including them into safety standards?

○ Through the public hearing and administered surveys, expert opinions on the above questions were gathered. As for the appropriateness of the categorization system, 72% answered that it was appropriate; 12% replied that items needed adjustment while 16% voiced that the system was inappropriate.

Composition of Categorization System



○ Concerning the last question, the majority answered that the standards should be included into the safety standards. Responses are shown in the figure below.
In particular, considering that most of the safety accidents are caused by human faults, many suggestions were made to make management standards into databases.



○ Another expert commented that in the industrial/construction safety category, the industrial category is relatively weak. The expert made the observation that since industrial sites are so wide in scope, it would be best to separate it from construction safety and instead make the industrial category a category of its own. Furthermore, there was also an observation that fire protection did not receive a category of its own, although the majority of safety accidents are related to fires. For these two observations, the following decisions were reached. In regards to the first suggestion, the Ministry of Employment and Labor is the only entity responsible for the legislation of laws on industrial safety. Since there are not that many laws on industrial safety, it is difficult for industrial safety to stand as a category of its own.

Thus, the category was decided to be kept as it is-i.e. industrial is kept together with construction safety. For the second suggestion, the decision was to exempt fire protection from the major areas of the categorization system. As with electricity and gas, related safety departments and task scopes will be considered in the case of fire protection.

Based on expert opinions, a DB system was created.

D. Setting up of a DB according to the Categorization System of this Study

○ The core purpose behind setting up a categorization system for safety standards is to create a database of the many legal provisions related to safety as administered by the different government departments. Such a database could prevent the legislation of redundant and similar safety standards. At the same time, the database would act as the foundation of a comprehensive and systematic database system for safety standards management. Through the database system, the contents of the safety standards made by different departments could be inspected and utilized. The safety-related legislation and administrative rules included into the categorization system would be well linked with one another. Ultimately, the system would allow citizens and public officials alike to become aware of their respective roles and responsibilities for safety. Thus, they would contribute and work together to prevent safety accidents.

To bring about such a database system, specific safety standards and related legislation, provisions, and administrative rules that fall under the categorization system's eight major categories were investigated. Then the researched items were made into a database. With the database creation, the different legal provisions in the categorization system were linked with one another. Also, the appropriateness and accessibility of each of the items in the categorization system were considered.

The DB composition is as follows.

Figure 5) Main Screen of DB Program

The eight major categories of the categorization system that have been created by this study are the basic components on the system screen. The DB is a tree structure and has a UI design so that the categorization system may be accessed by the following categories: major, tier-one, tier-two, and tier-tree. Legislation, provisions, and administrative rules as analyzed by the categorization system can be clicked in the tree structure. Once they are clicked, the DB program has been designed so that related legislation lists, provision lists, and administrative rules list pops up on screen.

Figure 3) Screen after Specific Item has been clicked on DB Program

An additional function allows the selection of specific conditions such as humans, facilities, materials, environment, and others. When the conditions are selected, a customized list according to the selected conditions is presented. Thus, checking for redundancies and differences between legislations could be done with higher efficiency.

4. Results and Anticipated Effects

To include all safety standards of all departments in a comprehensive manner, a categorization system has been created with eight major categories, the categories being chosen based on six categorization principles. Surveys were administered to test the validity of the created categorization system. Survey results showed that the majority of the experts surveyed deemed the categorization system of this study to be appropriate. The results of the categorization system, after it had gone through expert validation, were reflected in the *Enforcement Decree of the Framework Act on Management of Disasters and Safety*.

To increase accessibility of the safety categorization system, the analysis data of legislation related to specific items in the categorization system was made into a database. With the database, the different legislations and administrative rules for a given facility may be checked for redundant and differing items. Therefore, the database could be utilized as a foundational reference program in the drafting and enacting of new safety regulations. Furthermore, the categorization system could cut work time and improve work efficiency for safety personnel in different departments. Additionally, through public services, the system would allow for the public to know what part they could play in ensuring their own safety. Thus, the system proposed by this study is expected to maximize the effects of safety management.

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