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Design of Mobile App for Safety Management in Small and Medium Manufacturing Industries

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Abstract

Purpose: According to the Ministry of Employment and Labor, the proportion of accidents in the construction and manufacturing industries accounts for more than 50% in 10 industrial sectors in Korea, and there is little gap between the two. However, compared to the construction industry, on-site applications and development of safety management app. are not actively carried out in the manufacturing industry. Based on data from the Ministry of Employment and Labor and the National Statistical Office, this paper analyzes disasters in the manufacturing sector, explains the main operating principles and main components of the app. in the current safety management mobile app, and analyzes necessary improvements and functions through analysis of disasters based on actual accident. Through this analysis, the main inspection process and various mounting functions of the safety management app are explained, and improvement directions that will be more useful if added to the current safety management app are presented. By utilizing these improvements, we intend to further maximize the effectiveness of the app. and provide a safer use environment for users.
establishment of effective IAQ management policies and the creation of healthier learning environments.

Keywords : Mobile Application, Safety, Management, Design

JEL Classification Code: L60, L63, O31

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1. Introduction

1.1. The Background of the Study

According to the statistics of the Ministry of Employment and Labor's total number of accidents by industry in 2018 to 2022, the total number of accidents was 27,141 (26.7%) in manufacturing out of 101,574 cases in 2018, 27,470 (27.0%) in construction, 29,003 (26.7%) in manufacturing out of 108,434 cases in 2019, 27,024 (24.9%) in construction, 28,597 (26.6%) in manufacturing out of 107,620 cases in 2020, 26,615 (24.7%) in construction, 31,366 (25.7%) in manufacturing out of 121,852 cases in 2021, 29,812 (24.5%) in construction, 31,223 (24.2%) in manufacturing out of 129,123 cases in 2022, and 31,106 (24.1%) in construction. In addition, it can be seen that the proportion of accidents in the construction and manufacturing industries accounts for more than 50%, and there is little difference in share between the two industries.

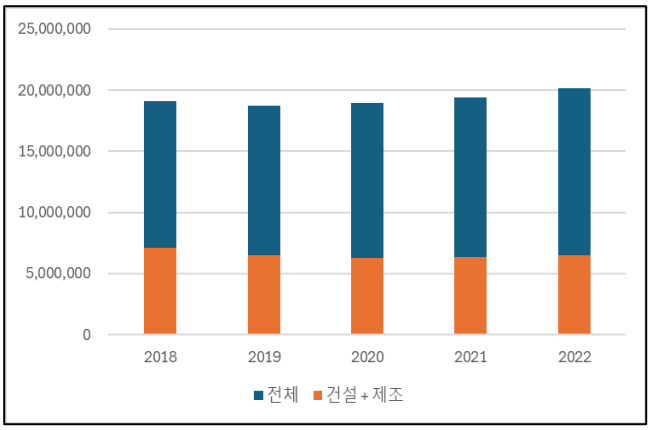

Figure 1: The ratio of the number of workers in the construction and manufacturing industries to the total industry

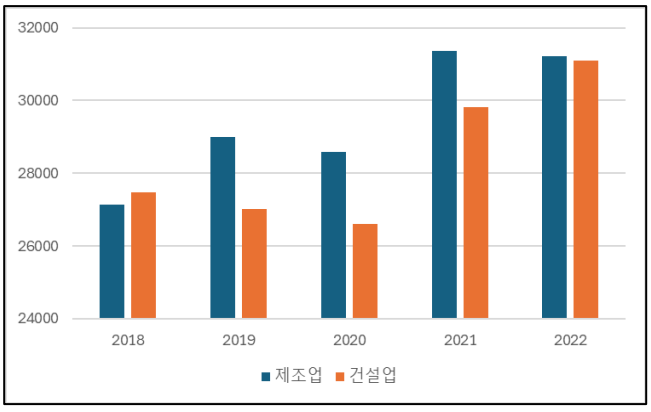

Figure 2: Number of accidents in construction and manufacturing industries

1.2. The Purpose of the Study

In the manufacturing industry, field applications and developments through the use of safety management apps are not actively carried out compared to the construction industry. In addition, the smart safety management application of the safety and health management app in the small and medium-sized manufacturing industry is still weak compared to the construction industry. Looking at the size of domestic companies, SMEs are relatively lacking and inactive safety and health management apps developed and operated by themselves compared to large companies.
Therefore, this paper describes the main components of the design and app for safety and health management mobile apps suitable for small and medium-sized manufacturing industries in Korea, and studies the application plan and expected effects through efficient operation and related survey analysis.

1.3. Introduction

Based on the statistical analysis of industrial accidents over the past five years by the Ministry of Employment and Labor and the National Statistical Office, this paper aims to derive disaster characteristics in the manufacturing sector and examine major contents such as the operating principles of the safety and health management mobile app and the components of the app currently used in Korea. Therefore, this paper aims to study and present necessary improvements and mounting functions through statistical analysis of disasters occurring based on industrial accident statistics over the past five years.
Additionally, through additional research, the design and mounting functions of major processes, such as safety inspections of safety and health management apps, will be reviewed in detail, and research on ways to improve them will be more useful if they are added to the current safety management app. Reflecting these improvements, we intend to further maximize the effectiveness of the app and provide a more convenient use environment for users.

1.4. How Safety Management Mobile App Works

Workers use the safety management mobile app to promote work to managers and partner companies by using photos and video images for inspection of harmful risk factors. Managers and partner company managers see the image, identify harmful risk factors, discuss improvements and measures, and review them. Through this feedback procedure, smart safety inspections can be conducted to promote disaster prevention in advance.

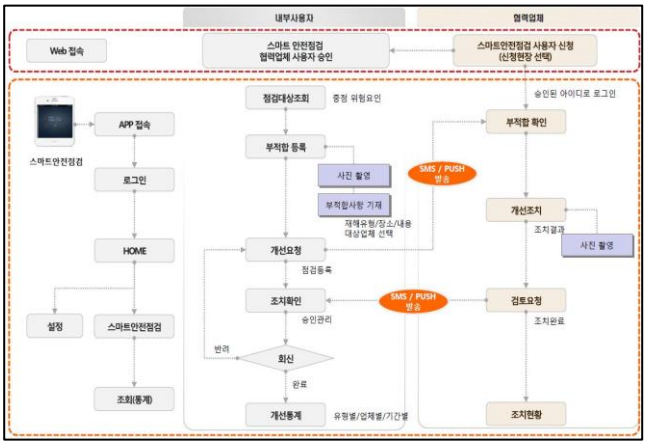

Figure 3: System Operation Principles of Safety Management Mobile App

2. Key Components of Mobile Apps

2.1. Attendance Management Functions

Workers can prove their work records through the attendance management function, and managers can check workers' attendance status and current work status in real time.

2.2. Integrated CCTV Features

Through integrated CCTV, managers can monitor the work status of workers in the workplace in real time to check the safety management status and use it to prevent accidents.

2.3. Emergency Response Function

In the event of a dangerous situation in the field, the manager can identify the relevant situation in stopping the work and take immediate action to stop the work. Workers can quickly notify dangerous situations through the application of the emergency button function, enabling quick response.

2.4. Task Management Features

Workers, safety, and health managers can identify the work to be performed today in advance and prevent accidents by enabling real-time monitoring of risk factors of the work.

2.5. Safety Court Document Management Function

It is useful for complying with legal requirements and makes the promotion of safety and health management activities more efficient by providing a quick understanding of legal regulations related to the Serious Accident Punishment Act, the Occupational Safety and Health Act, the Fire Act, the Hwagwan Act, and the Risk Assessment (TBM).

2.6. Safety and Health Education Management Function

Workers can easily and effectively learn various safety and health education through the use of video-based safety and health mobile education content, and managers can identify and manage the progress of legal education in real time.

2.7. Safety and Health Management ChatGPT Function

Using artificial intelligence, workers and managers can provide immediate responses to questions related to serious disaster cases, allowing them to provide necessary safety and health information more quickly.

2.8. Foreign Language Support Features

It provides a variety of language options to help foreign workers understand safety and health information more accurately and quickly.

3. Design Direction of Safety Management Mobile App

3.1. Attaching Protection Real-time Monitoring Sensor

3.1.1. Summary

One of the main causes of accidents that occur during work is that the protection device is not operating properly or is not attached. To prevent this, a real-time monitoring sensor for the protection device is installed to ensure that the protection device is attached and operating normally while using the device, and a real-time monitoring and warning system is established.

3.1.2. Warning process without protection

Monitor protection during work: If a machine, such as a round saw, does not have a protective cover installed or the work begins with the protective device not operating normally, the sensor immediately detects it and triggers an alarm.

Send warning sounds and alarms: When work begins without protective devices attached, the device will sound an alarm and a real-time notification will be sent to the safety manager and personnel.

Manager Reminder: The notification emphasizes that measures are needed for the safety of workers, and is delivered with details. Example notification phrases are as follows.

Notification Statement:

"Warning: 00 staff is operating the device without protection. Please check and take action immediately."

3.1.3. Expectation effectiveness

Real-time Safety Management: Accidents caused by the absence of protective devices in the workplace can be prevented in advance, and managers and partners can identify and take action in real-time.

Spreading safety culture: Continuous monitoring of compliance with protective devices can make workers aware of safety and establish an overall safety culture.

This can reduce the risk of accidents in the workplace and improve the safety level of workers and workplaces.

3.2 Speech Recognition Function

3.2.1. Summary

In order to reduce the risk of being unable to use hands while working, a safety management system using voice recognition is implemented. It is designed to warn of dangerous situations and enable immediate response through voice recognition in work situations where it is difficult for workers to use their hands.

3.2.2. Risk Notification Process with Speech Recognition

Dangerous situation Voice detection: For example, if a mold jamming accident occurs while installing a mold in an injection molding machine, it may be difficult for an operator to respond with his or her hands. In preparation for this situation, the system detects and automatically sends out a signal when an operator shouts a specific voice command (e.g., "help," "emergency")..

Propagate immediate notification: After voice detection, the system notifies managers and nearby workers of dangerous situations in real time. The notification includes the location and content of the accident, and allows workers to immediately seek help.

Notification Example Phrases:

"Warning: 00 operator voice call detection – dangerous situation during mold installation. Please check immediately."

"The 00 worker is complaining of the risk of mold jamming. Please support the worker nearby immediately."

3.2.3. Expectation Effectiveness

Improved emergency response efficiency: In emergency situations where hands are unavailable, you can immediately ask for help with just your voice, enabling you to respond quickly in the event of an accident.

Improve workplace safety: Quick notification in emergency situations allows other workers and managers to quickly support and increase workplace safety.

Providing a sense of psychological stability: The presence of countermeasures against risks that may arise during work by workers gives them a sense of psychological stability, and the effect of establishing a safety culture can be expected.

The system will contribute to improving the safety of the workplace by supporting workers to easily ask for help even in urgent situations.

3.3. Expand the Information Content of the Disaster Prevention Bulletin

3.3.1. Summary

Small workplaces often have difficulty in effective disaster prevention due to limited manpower and equipment. In order to overcome this problem, a plan is established to increase the usability of various and latest safety and health information by referring to disaster prevention programs of other companies working in the same field and establishing and operating a disaster prevention bulletin board that can share disaster prevention programs in the company.

3.3.2. Operation of bulletin boards and expansion of the use of partner companies

Activation of sharing safety information: To prevent possible accidents in the workplace, share disaster prevention know-how and its programs in other workplaces on the bulletin board.

Information exchange with internal and external partners in the industry: Internal and external workers working in the same industry post each other's accident prevention programs and induce discussions on improvement measures to enhance the overall safety of small and medium-sized business partners.

3.3.3. How to use the bulletin board

Upload disaster prevention programs: Each workplace uploads its disaster prevention programs on the bulletin board. Prepare detailed information for reference to other workplaces, including the details of the program, purpose, applied cases, results, and improvements.

Check other workplace programs: Other workplace workers in the same industry may check the posted programs and apply them, if necessary, modified to suit their workplace environment.

Update information: Periodically update improvements at our and other workplaces, new disaster prevention programs to encourage us to share the latest information.

3.3.4. Expectation Effectiveness

Improve workplace safety: By sharing disaster prevention cases in various workplaces, appropriate precautions can be reviewed and applied in small workplaces.

Problem solving through experience sharing: Improve to share know-how and solutions for industrial accident cases that may occur in common within the industry to contribute to joint discussion and resolution of various accident cases at individual work sites.

Improving the level of prevention programs: As various ideas can be obtained from disaster prevention activities in other workplaces, a higher level of accident prevention can be expected by supplementing and improving their own safety activities programs.

The operation of the above disaster prevention mobile bulletin board will play an important role in raising worker safety awareness and spreading safety culture in small workplaces.

4. Conclusion

4.1. The Value of the SME Safety and Health Management App

This safety management mobile app has important value in manufacturing, especially small workplaces. This app can greatly contribute to the prevention of safety accidents and improvement of the working environment by providing the function to identify workplace risk factors in advance and report in real-time. The app's protection device monitoring and voice recognition functions enable immediate response to mechanical problems or urgent situations, and will greatly contribute to overcoming the limitations of small workplaces by sharing safety information between workplaces through the operation of safety information bulletin boards.

Therefore, the app plays an important role in strengthening safety management for both workers and managers, and in the long run, it will also be a useful tool for preventing serious accidents and creating a safe working environment.

4.2. Conclusions and Expected Effects

This study reviewed and presented major contents related to the development of mobile applications to efficiently promote safety management activities for small manufacturing workplaces. In consideration of the fact that the introduction and research on smart safety in the manufacturing industry compared to the construction sector are somewhat insufficient, a mobile app model for efficient safety and health management in small and medium-sized manufacturing industries was designed and expected effects were derived.

The safety management mobile application presented in this study is a small and medium-sized manufacturing app model that enables workers to alarm risk factors in real-time to managers, enables smart safety checks, and supports document management and online education and training functions using ChatGPT for searching and confirming the latest various safety laws, artificial intelligence-based Q&A functions, and foreign language support functions for foreign workers.

This app is equipped with a protective device monitoring sensor and voice recognition function to identify whether the protective device is attached or not in operation in advance, to alert, to respond quickly in the event of an emergency, and to resolve the limitations of the workplace and improve overall safety by actively utilizing the bulletin board to exchange information between the headquarters and partners and to share disaster prevention programs.

It was confirmed that this SME safety and health management application can be used as an important means for effective safety management in small workplaces. Through this, it was found that it can play an important role in strengthening the safety of domestic SME workers and preventing accidents. In addition, the introduction of mobile applications in the future is expected to make an important contribution to establishing a safer working environment in the long term in the domestic SMEs manufacturing industry.

References

Jin, J. I. (2019). A study on the utilization of construction safety management mobile app (pp. 24–27).

Ministry of Employment and Labor. (2018–2022). Industrial accident status: Total accident status and analysis - By industry (medium classification by industry). Retrieved December 6, 2024.

Hyun, S. Y. (n.d.). Anjunham. Retrieved from http://anjunham.kr