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A new approach for explosion accident prevention in chemical research laboratories at universities

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Abstract

Over the years, many types of accidents, including explosions during chemical experiments, have occurred at universities around the world, and such accidents could kill faculty members, researchers, graduate students or students(Ayi et al., 2018; Young et al.,1983). While it is unclear how many accidents have occurred in chemistry laboratories at universities, such accidents have subsequently recurred at other universities, and in these cases, no paradigm shift or drastic changes have occurred regarding laboratory safety (Ménard et al., 2020). Until now, research and education on chemical accident prevention at universities has focused mainly on respective measures taken in response to each accident (Kemsley, 2009), overlooking the mechanisms of accident occurrence. However, the field of aviation has seen a reduction in aircraft accident rates because of unified accident investigation, education and training, with a focus on mechanisms of accident occurrence (Wiegmann et al.,2003;Stozer et al., 2008), and illustrates that the approach taken by the field of aviation is effective to reduce accidents. In this study, accident investigation reports of the explosion of chemical substances and an inflammable mixed gas in chemistry laboratory at two universities were re-analysed with an analysis tool based on the software/hardware/environment/ liveware (SHEL) model (Hawkins, 1987). As a result, although each accident was expressed as a different event, the analysis of the contributing factors of each accident showed that some accident contributing factors were common, the contributing factors to the accident can be used as learning experiences at other universities, and university accidents can be explained by the same epidemiological accident models as in the field of aviation and marine. In order to reduce accidents, universities around the world must come together to formulate accident investigation rules, including accident investigation processes, accident models, investigation and analysis methods, report making, to conduct education and training for investigators at universities, and to hold a regular conference for these investigators to exchange lessons to reduce accidents (Fukuoka et al., 2022).

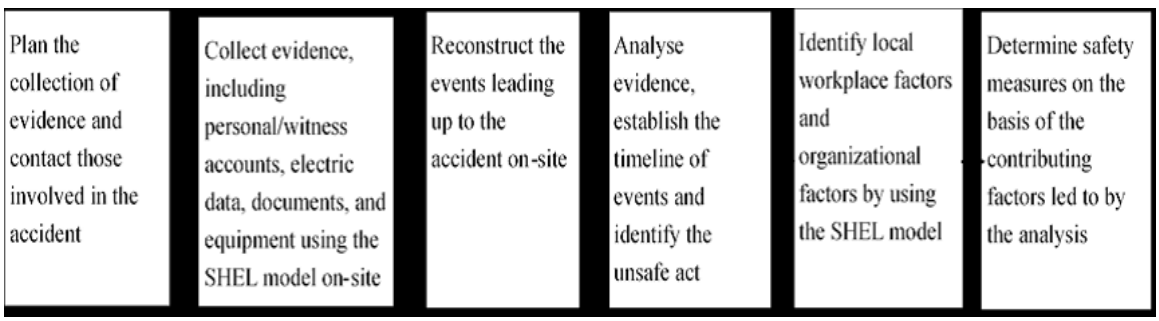

Fig. 1 Flow chart on how an accident should be investigated (Fukuoka,et al., 2022)

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Significance of the work

Until now, accident investigation analyses and preventive measures with a focus on the mechanism of accident occurrence at university chemistry laboratories have not been discussed. In addition, it was not clear to which of the three accident models the accidents occurring at universities were classified (Hollnagel, 2004; Fukuoka, 2019). In this study, it was clarified for the first time that accidents at universities are classified under the epidemiological accident model which has a cause-and-effect link and numerous contributing factors. Furthermore, the study made clear recommendations for the systematic accident prevention at universities, including that universities around the world should come together to formulate guidelines for accident investigation and analysis (Fukuoka et al., 2022).

Biography

Koji Fukuoka, as an accident investigator at Japan Transport Safety Board of the Ministry of Land, Infrastructure, Transport and Tourism, has conducted numerous accident investigations, analysis, and accident investigation report writing. He was an International Maritime Organization (IMO) consultant for the IMO Model Course: Safety Investigation into Marine Casualties and Marine Incidents. He has worked on accident occurrence mechanisms and prevention and developed a new accident model, which combines the Swiss cheese model, the SHEL model, and the safety management system. The analysis tool based on the SHEL model mentioned in this abstract is equivalent to his developed new accident model. He published articles, reviews, and a book on accident mechanisms, accident models and accident prevention. He was involved in university safety-related work as the manager of the Occupational Health and Safety Section at the Okinawa Institute of Science and Technology Graduate University, and as a professor at Kyushu University. He works in social engineering systems, safety engineering, and scientific accident prevention including accident prediction.

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