The determinant of fire disaster mitigation (fire practices study in gas station operator Surakarta, Indonesia)

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Abstract. Gas station is the working areas which have a high risk of a fire disaster, which can be caused by unsafe behaviour or unsafe condition. In dry season, Surakarta is one of the cities in Indonesia that has a hot temperature as a result of global climate change. This condition can allow the fuel to evaporate easily and trigger of the fire triangle. The purpose of this study was to examine the most influencing factors related to the fire safety practices in the gas station operator, including safety regulations, fire training, and fire prevention and mitigation facilities. This study was analytic observational research using a cross-sectional approach. The sample was 94 gas stations operators in Surakarta. The instrument used in this study was a questionnaire which is tested in validity and reliability. The data were analysed using chi-square and logistic regression. The result showed that the variables of fire prevention and mitigation facilities show a dominant correlation to the fire safety practices (p-value=0.0001, exp B=20.159).

1. Introduction
Gas station is one of the working areas which have a very high level of a fire accident. That fire accident can cause enormous damage to workers, properties, and the environment around the gas station area. The explosion or fire at the gas station may result from the reactions between heat, fuel, and oxygen [1]. The use of prevention and mitigation facilities is an important element in preventing and mitigating the incidence of fire or explosion [2]. In many countries, there had been accidents at the gas station caused by the limited facilities and safety standards in the workplace, prompting the labor to behave unsafely [3]. In dry season, Surakarta has a hot temperature as a result of global climate change [4]. This condition can allow the fuel to evaporate easily and trigger of fire triangle.

The safety behavior of the worker is very important in the prevention of accidents in the workplaces. The risks of working accident may be influenced by unsafe condition and unsafe behavior from the gas station workers or people around this area [5, 6]. In addition, simulations and training are also important to establish safety behavior and prevent fire at the gas station. Regular training makes workers accustomed to behaving safely in preventing and mitigating accidents at the workplace. According to Green, human behavior is influenced by three main factors i.e. predisposing factors, enabling factors, and reinforcing factors [7]. Assessment of the enabling factors in fire safety practices is still rare, even in international journals. The purpose of this study is to examine the enabling factors related to the fire safety practices in the gas station including safety regulations, fire training, and fire prevention and mitigation facilities.
2. Subject and methods
This study used the analytic observational design with a cross-sectional approach. The study was conducted in Surakarta City which is located in Central Java. The population in this study was gas station operators that worked in the gas station location in Surakarta. The selection of respondent using total sampling method, the sample in this study were 94 gas station operators that have job description fueling the vehicle tank.

The data were collected using a questionnaire given to the gas station operators. The scale of measurement on the instrument using 4 level scale of Likert, where a score of 4 signaled strongly agree, 3 for agree, 2 for do not agree and 1 for strongly disagree. The instrument used in this study had previously tested in validity and reliability. Each respondent in this study has filled out and approved the inform consent before the data was taken. This study aimed to determine the most influential enabling factors towards the fire safety practices at the gas station operators in Surakarta.

The research questionnaires variables consist of the perception of the gas station operators on training, safety regulations, fire prevention, and mitigation facilities and fire safety practices at the gas stations. The scale of research data included in the scale of data category and was analyzed using chi-square and logistic regression statistic test. Analysis of the data using SPSS ver.17 to determinant the most influent factor related to fire safety practices at the gas stations.

3. Results
This research was conducted in Surakarta, Central Java. The gas stations in this study are the partner of Pertamina Co. Ltd as a state-owned provider of fuel domestic purposes in Indonesia. This company has required every gas stations that have partnered to prioritize safety aspects especially in fire training on workers, safety regulation at workplaces, and fire prevention and mitigation facilities.

Respondents in this study are the gas station operators in charge of filling fuel to the consumer’s vehicle tank. The study involved 94 subjects who were qualified for eligibility criteria. Table 1 shows that the categories of fire training, safety regulations, fire prevention, and mitigation facilities and fire safety practices on gas station operators are mostly in the good category. Whereas in table 2 showed all of the variables show significant correlation towards safety practices (p-value<0.05). Table 3 indicates that the fire prevention and mitigation facilities show a dominant correlation to the fire safety practices on gas station operators (p-value=0.0001, exp B=20.159).

Table 1. Respondents distribution of fire safety practices in the gas station

| Variable                        | Category | Frequency | Percentage |
|---------------------------------|----------|-----------|------------|
| Fire trainings                  | Bad      | 43        | 45.7 %     |
|                                 | Good     | 51        | 54.3 %     |
| Safety regulation              | Bad      | 30        | 31.9 %     |
|                                 | Good     | 64        | 68.1 %     |
| Fire prevention and mitigation facilities | Bad | 28 | 29.8 % |
|                                 | Good     | 66        | 70.2 %     |
| Fire safety practice           | Bad      | 29        | 30.9 %     |
|                                 | Good     | 65        | 69.1 %     |

4. Discussion
To eliminate the risk of fire in vulnerable populations, it is necessary to plan for mitigation and prevention programs i.e with fire safety training. Fire safety training is one of the most important prevention programs since most workplace accidents happen to workers who are not accustomed to working safely. According to several studies, it may because of the lack of education and knowledge of the hazards or how to prevent it even though the workforce is aware of risk around it [8, 9].
The fire safety practice of gas station operator training was in a good category, around 86.3%. This indicated that training held by the company can affect the fire safety practice of the workers. This study was not in line with research conducted by another study on 400 construction workers in the United State that safety training has no significant correlation to safety practices. Some training was not sufficient to alter labor behavior towards safety in the workplace without the support of adequate safety facilities [10]. In the developing country, safety training is an important issue that should be considered as an education to prevent an accident at work [11]. Based on the observation in 5 gas stations of Surakarta city, only 1 gas station that implements the routine training and simulation to prevent fire at works. The fire simulation in the form of how to operate the fire extinguisher, traditional extinguisher, hydrant, and fire evacuation technique [12]. The fire emergency response training also intended to ensure maximal protection to decrease the impact of the fire that occurred against the environment. Moreover, the usage of hazardous, toxic, and flammable materials in the gas station also need special handling training in case of fire, the using of water is not enough to extinguish the fire caused by fuel, hot, and oxygen [13].

The regulation and standard of fire safety must be applied to prevent work accident. The regulation and standard in gas station including Standard Operational Procedure (SOP), working instruction, standard working area, standard entering gas station area, standard facilities, etc. [14]. The organized safety regulation must be binding to both workers and consumers who visit the gas station [15]. The chi-square test result indicated that fire safety regulation and fire safety practice was a significant correlation with p-value 0.001. Meanwhile, the frequency distribution result also obtained that the perception of gas station operation about fire safety regulation was in a good category (79.7%).

Result of this research was in line with some study in Europe that safety culture and regulation correlates with occupational health and safety practices, this can be indicated that the more positive the safety culture, the better the safety practices program. This also applies the other opposite, that the more negative the safety practice program, the worse the safety practices program [16]. Besides, the good regulation should be supported by enabling factor to sustain safety behavior. The good regulation and standard able to improve safety performance at the working area, prevent unsafe behavior and action, and if obeyed properly, the work accident can be avoided [17].

Based on logistic regression result, the fire safety regulation was not dominance against the fire safety practice of gas station operator with p-value 0.867. This can be affected by several other factors that contribute to personal behavior, one of them was risk management. The regulation and standard without safety management and good control, the safety performance of workers tend to decline from

| Table 2. Bivariate analysis of fire safety practices using chi square statistical test |
|------------------------------------------|------------------|------------------|----------|----------|
| Variables                               | Fire safety practices (N%) |                  |
| Category                                | Good (48.8%)      | Bad (51.2%)      | Total    | P-value  |
| Fire training                           | 21 (43%)          | 22 (51.2%)       | 43 (100%)| 0.0001   |
| Safety regulation                       | 44 (86.3%)        | 7 (13.7%)        | 51 (100%)| 0.001    |
| Fire prevention and mitigation facilities| 28 (100%)         | 19 (67.9%)       | 47 (100%)| 0.0001   |

| Table 3. Multivariate test results with logistic regression |
|-------------------------------------------------------------|
| Research variable  | Wald  | P-value | Exp. B |
| Fire training     | 11.227| 0.001  | 11.829 |
| Safety regulation | 0.028 | 0.867  | 0.895  |
| Fire prevention and mitigation facilities | 16.391 | 0.0001 | 20.159 |

The chi-square test analysis indicated that fire training was a significant correlation with fire safety practice with p-value 0.0001. This was similar to the observation results that the percentage of gas station operator training was in a good category, around 86.3%. This indicated that training held by the company can affect the fire safety practice of the workers. This study was not in line with research conducted by another study on 400 construction workers in the United State that safety training has no significant correlation to safety practices. Some training was not sufficient to alter labor behavior towards safety in the workplace without the support of adequate safety facilities [10]. In the developing country, safety training is an important issue that should be considered as an education to prevent an accident at work [11]. Based on the observation in 5 gas stations of Surakarta city, only 1 gas station that implements the routine training and simulation to prevent fire at works. The fire simulation in the form of how to operate the fire extinguisher, traditional extinguisher, hydrant, and fire evacuation technique [12]. The fire emergency response training also intended to ensure maximal protection to decrease the impact of the fire that occurred against the environment. Moreover, the usage of hazardous, toxic, and flammable materials in the gas station also need special handling training in case of fire, the using of water is not enough to extinguish the fire caused by fuel, hot, and oxygen [13].

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time to time [18]. The good control can be done in the form of worker behavior inspection, equipment inspection, reporting the unsafe condition and action, reporting danger, etc. [19].

The fire prevention and mitigation facilities were all media that related to safety and preventing the fire in gas station area according to the technical requirement that had been specified by Pertamina Co. Ltd and the management of the gas station. Every gas station must install fire extinguisher on each operate fuel dispenser and provide hydrant installation around gas the station area [20]. Based on the correlation test with chi-square showed that between the fire prevention and mitigation facilities toward the fire safety practice was significant with p-value 0.0001. This result was in line with some study especially the fire safety facilities enable independent and adequate fire response performances by the building’s occupants [21]. The insufficiency of fire equipment becomes an enabling factor that is very risky to the safety of in case of fire hazard at the workplaces [22].

According to the Indonesian National Standard (SNI 03-1745-2000), each hydrant pipe must be regularly checked, either the water pressure or its pipe condition. The defective, damaged condition, even expired fire extinguisher must be replaced with the new fire extinguisher. Moreover, in each working area where have a potential disaster and fire also required an evacuation facility and gathering point to encounter emergency [23].

The result of the multivariate test with logistic regression, the variable of fire prevention and mitigation facilities showed a dominant correlation to the fire safety practices (p-value=0.0001, exp B=20.159). This was similar to the other study, fire prevention and evacuation facilities were affect the safety at work and emergency prevention [24, 25]. In domino accident theory, the provision of fire safety equipment and facilities is one of the methods to prevent work accident [26]. The provision of safety facility which is not following with standard able to trigger more severe incident and accident, the using of facilities is expected to minimize the severity of the accident and occupational diseases. Furthermore, the knowledge and control of facilities also become important attention because the provision of facilities is not enough without knowledge and practice to use safety equipment at work [27, 28].

5. Conclusion

Surakarta is one of the cities in Indonesia that has a hot temperature as a result of global climate change. This condition can allow the fuel to evaporate easily and trigger of the fire accident. The prevention of fire disasters can be implemented by controlling the environment and worker behavior. In this study showed that variable of fire prevention and mitigation facilities (p-value=0.0001, exp B=20.159) has domination correlation with fire prevention and practices in the gas station. The management of gas stations must provide standardized of evacuation and mitigation facilities to prevent the fire disasters and losses of workers, properties, and the environment around the gas station area.

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