Risk assessment for safety laboratories in Politeknik Negeri Medan

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Abstract. International Labour Organization (ILO) estimated 2.34 million people die each year because accidents and diseases in workplace. It also impact to economic losses in some countries. It need to do safety and healthy in working environment especially in laboratory. Identification of potential hazards and risks must be done in Telecommunication Laboratory Politeknik Negeri Medan. Therefore, this study was assessed 5 of potential hazards and risks in our laboratory by Likert Scale. This object was divided into 2 assessment namely likelihood of hazards and severity of consequences. Collecting data is taken from questionnaire who involved 100 students at random academic level. The result showed The highest score is chemical hazards 73.2% in likelihood of hazards and electrical hazards 85% in severity of consequences. This condition is classified as “high” state. Big attention must be given to “high” state because it can help us to determine mitigate action.

1. Introduction
An estimated 2.34 million people die each year because of work related to accidents and diseases in workplace. The vast majority, 2.02 million die because of diseases. The ILO also estimates that 160 million cases of non fatal work related diseases occur annually [5]. Economic losses that could be caused by accidents and diseases attain 4% of PNB (Product National Brute) in some countries.
In past time, accidents and diseases in workplace is an evitable part of production. Now, government have regional and international standard about safety because human and social cost is very expensive. Millions of peoples are working under the risk. It need to do safety and healthy in working environment especially in laboratory. According to this fact, identification of potential hazards and risk must be done in our laboratory.

This study aims to identify and assess some potential hazards and also estimate the level of the risk. Data information could be acquired from all students by questionnaire form. The answer of questionnaire must be filled and collected by students. Finally, estimates level of the risk by Likert Scale.

There is clear mechanism how to identify and assess the problems particularly potential hazards and risk in laboratory. Realization of development of safety and healthy in laboratory are came from the peoples who work there. Processes and technology are not enough to drive a safety environment without human force. Therefore, based on Knowledge Management System (KMS) concept that knowledge managing effectively, attention must be paid on to four key components: Knowledge, People, Process and Technology (KP2T) [1][3][4].

2. Literature Review
2.1. Knowledge Management System
Four key components of knowledge management in many organisations have realized that technology based on competitive advantages are transient and that only sustainable competitive advantages they have are their employees and so to remain at the forefront and maintain a competitive edge organisations must have a good capacity to retain, develop, organise, and utilise their employee competencies [7][9]. Knowledge management as a concept to play a critical role in shaping the future of each organisation.
because decisions, action and inaction taken by managers and it can often result in the successful execution of operations for the organisation.

The most important activities in laboratory is about safety. People who works in laboratory is engaged with on a daily activities in safety concept. Safety as primary requirement in laboratory because it related to human soul. Safety concept will be effective and efficient if we use knowledge management. It can help us to make decisions and determine the success or failures of the laboratory activities.

2.2. Likert Scale
Likert scale is so popular for measurement to collect data about the emotional intelligence competencies early. Likert has a capacity to measure the attitude of the respondents easily. Moreover, it is easy to make statements to capture the essence of a specific construction. It is also easy to understand and respondents feel easy to provide their perception through Likert type format [2][6][8]. This research uses five point scale of likelihood and five point scale of severity of consequences. State of five point scale can be used to assess identification of potential hazards in laboratory. Related questions are written on paper questionnaires and completed the five point scale.

3. Method
Analytical stages have been summarized into 4 major stages.

3.1. Preliminary Observations
The first stage, we do analyse of potential hazards and collecting data in laboratory. This is a preliminary observations involved the students and answer questionnaire to obtain information relating about hazards and impacted towards learning process. There are 5 identification of potential hazards in laboratory. They are consist of:

- Chemical Hazards
- Electrical Hazards
- Ergonomic Hazards
- Fire Hazards
- Physical Hazards

3.2. Document Control
The second stage is designing the document control. Document control contains some questions related to kind of hazards. Document control are answered by adapting to existing conditions and objectives. Instructional questions are refer to the syllabus which expect to support teaching and learning activities and practice. The result of document control is necessary to assess the risk of hazards.

3.3. Classified of Risk Assessment
The third stage, hazards are classified into 2 assessment namely likelihood of hazard and severity of consequences. We use Likert scale to estimate the level of potential risk. Risk assessment as shown in table 1.
Table 1. Risk Assessment.

| Likelihood of Hazard | Severity of Consequences |
|----------------------|--------------------------|
|                      | Insignificant (1) | Minor (2) | Moderate (3) | Major (4) | Catastrophic (5) |
| Rare (1)             |              |           |             |          |                 |
| Unlikely (2)         |              |           |             |          |                 |
| Possible (3)         |              |           |             |          |                 |
| Likely (4)           |              |           |             |          |                 |
| Almost certain (5)   |              |           |             |          |                 |

Explanation of likelihood of hazard:
- Rare: it may occur only in exceptional circumstances.
- Unlikely: it could occur at sometime.
- Possible: it might occur at sometime.
- Likely: it will probably occur in most circumstances.
- Almost certain: it is expected to occur in most circumstances.

Explanation of severity of consequences:
- Insignificant: no injuries and low financial loss.
- Minor: first aid treatment, minor fire, damage or loss of containment.
- Moderate: medical treatment and outside assistance required.
- Major: permanent injury, major damage and total loss of containment.
- Catastrophic: death caused, toxic release off-site and huge financial loss.

3.4. Corrective Action
The fourth stage, we determine corrective action and action plan. Corrective action is made according to risk assessment. It should be considered as mitigate action. We do deep inspection about impact, form and process of a potential hazards. Next, we decide action plan as recommended action to mitigate potential hazards.

4. Result and Discussion
Collecting data is done in 5 questionnaire forms. The questions are divided into 5 parts of assessment of identification hazards. Each questionnaire is given to students of Telecommunication Engineering, Department of Electrical Engineering. Furthermore, the number of 100 students are involved in this study from random academic level. The form is consists of 7 experimental questions. It can be explained that the first 3 questions are about the risk which maybe arise caused by electrical shock. Thus, the second 3 experimental questions are about condition and impact to human caused by electrical shock. The last one, this is about action to eliminate potential hazards and any risks caused by electrical shock. Questionnaire form of identification electrical hazards can be shown in figure 1.
4.1. Discussion Response

Response of likelihood of hazards assessment is refer to table 2.

Table 2. Response of Likelihood of Hazards.

| Potential Hazards | Rare (1) | Unlikely (2) | Possible (3) | Likely (4) | Almost certain (5) | \( \sum_{i=1}^{5} n_i x_i \) | Index |
|-------------------|----------|--------------|--------------|------------|-------------------|----------------|--------|
| Chemical          | 2        | 8            | 27           | 48         | 15                | 366            | 73.2 % |
| Electrical        | 6        | 10           | 25           | 40         | 12                | 350            | 64.2 % |
| Ergonomic         | 22       | 28           | 30           | 13         | 7                 | 255            | 51 %   |
| Fire              | 20       | 24           | 37           | 10         | 9                 | 264            | 52.8 % |
| Physical          | 7        | 12           | 21           | 43         | 17                | 351            | 70.2 % |

Response of severity of consequences assessment is refer to table 3.

Table 3. Response of Severity of Consequences.

| Potential Hazards | Insignificant (1) | Minor (2) | Moderate (3) | Major (4) | Catastrophic (5) | \( \sum_{i=1}^{5} n_i x_i \) | Index |
|-------------------|-------------------|-----------|--------------|-----------|------------------|----------------|--------|
| Chemical          | 11                | 10        | 23           | 42        | 14               | 338            | 67.6 % |
| Electrical        | 0                 | 7         | 8            | 38        | 47               | 425            | 85 %   |
| Ergonomic         | 24                | 27        | 36           | 11        | 2                | 240            | 48 %   |
| Fire              | 4                 | 7         | 10           | 35        | 44               | 408            | 81.6 % |
| Physical          | 19                | 28        | 34           | 12        | 7                | 260            | 52 %   |
4.2. Mathematical Result

The detailed mathematical result for the determination of electrical hazards at severity of consequences is described:

\[
\text{Likert score} = \sum_{i=1}^{n} n \cdot x_i
\]

(1)

Likert score = 426

\[Y = \text{highest score} \times \text{total of students}\]

(2)

\[Y = 5 \times 100\]

\[Y = 500\]

\[\text{Index} = \frac{\text{Likert score}}{Y} \times 100\%\]

(3)

\[\text{Index} = \frac{425}{500} \times 100\%\]

\[\text{Index} = 85\%\]

Risk assessment remark is refer to table 4 according to interpretation of criteria in table 5.

Table 4. Risk Assessment Remark.

| Likelihood of Hazard | Severity of Consequences |
|----------------------|--------------------------|
|                      | Insignificant (1) | Minor (2) | Moderate (3) | Major (4) | Catastrophic (5) |
| Rare (1)             |                      |            |              |           |                  |
| Unlikely (2)         |                      |            |              |           |                  |
| Possible (3)         |                      |            |              |           |                  |
| Likely (4)           |                      |            |              |           |                  |
| Almost certain (5)   |                      |            |              |           |                  |

Table 5. Interpretation of Criteria.

| Percentage       | Likelihood of Hazard | Severity of Consequences |
|------------------|----------------------|--------------------------|
| 0 % - 19,99 %    | Rare                 | Insignificant            |
| 20 % - 39,99 %   | Unlikely             | Minor                    |
| 40 % - 59,99 %   | Possible             | Moderate                 |
| 60 % - 79,99 %   | Likely               | Major                    |
| 80 % - 100 %     | Almost certain       | Catastrophic             |
5. Conclusion

Conclusion can be referred as corrective action. These are made according to risk assessment remark. The red colour is “high” state and brown colour is “significant” state. That all risk should be considered as a potential danger resources. We give big attention about the impact of risks in high state. It can help us to determine mitigate action. For instance, how chemical spilled can contact or enter into our body and how it can be controlled. Personal Protective Equipment (PPE) is required to protect body such as respirator, gloves, dustcoat and many more. In other side, electrical hazards can be dissociated by direct touch. Isolate the active polar, closed by barrier or enclosure, create hurdles to give safe distance or out of range. Inspections must be done at all the time to ensure that all potential risk are identified. Sustainable action give us more advantages to maintain a potential hazards that may be arise at anytime.

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