Applications of HIRARC at UniMAP Laboratories

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***Abstract*- As a technical university which hands on practices are common to students, Universiti Malaysia Perlis (UniMAP) accommodates numbers of laboratories. From the basic fundamentals to the high-end laboratories, there might be possibilities for the operators; including technicians, PLVs and students to get involved in accidents. This research performed an occupational safety and health assessment based on a method called Hazard Identification, Risk Assessment and Risk Control (HIRARC) in selected laboratories in UniMAP. The study emphasizes on the identification of hazards, the hazard evaluation process, and the control measures taken to prevent accidents. The data then analyzed to determine the risk level and several recommendations are highlighted in order to reduce risk.**

***Keywords*- HIRARC, hazard assessment, safety and health, Occupational Safety and Health. OSH.**

I. INTRODUCTION

During the last decade, hazard identification has become a universal tool applied in industries. Huge improvements have been made in the way that most industries now manage their business, thankfully to a greatly reduced likelihood of a major accident [1].

Risk is important to be quantified and assessed in support for risk management, from initial screening and priority setting exercises to major regulatory decisions with profound people's health consequences [2]. Organizations that have already carried out risk assessment in their work, have experienced positive changes in their working practice, they recognize. Legislation requires that this hazard assessment process should be systematic and be recorded [3]. A hazard is defined as "a potential source of harm" and it requires big responsibilities of employers to determine its existence in their workplaces or jobsites [4].

Those who have already carried out risk assessment in their work, have reported positive changes in their working practice, they recognize substandard act and working condition as they develop and take necessary corrective action. Legislation requires that this process should be systematic and be recorded so that the results are reliable and the analyses complete [1].

II. METHODOLOGY

There are numbers of laboratories in UniMAP. In this research, about more than 20 laboratories being grouped into four main categories; Electrical and Electronics, Mechanical and Process, Computer, and Materials and Science laboratories. The overview of methods to complete this study of HIRARC is as shown in Fig. 1.

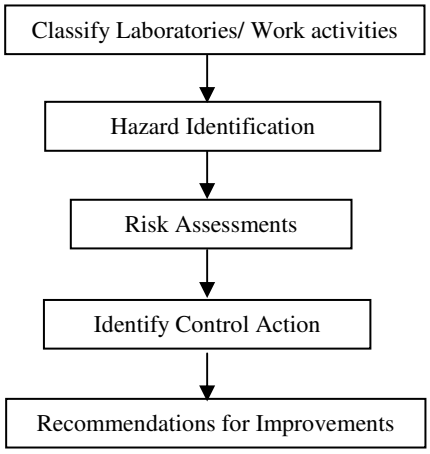


Fig 1. Study's Methodology

III. HAZARD IDENTIFICATION

In every task, there are some operations that can be classified as critical. All operations that contain hazards and posing significant risks to the health and safety of employees need to be identified. In order to identify them, those hazards classify as ergonomics, electrical, mechanical, chemical, air contaminants and safety hazards. Hazards need to be identified whether a particular hazardous agent is associated with health ecological effects that are of sufficient importance to warrant further scientific study or immediate management action, particularly in UniMAP [2].

In order to identify type of hazards exist in the laboratories, observations have been made by the team members. With the cooperation of laboratories' manager or technicians who are familiar with the equipments,

materials or substances, all the hazards are easily figured out. The scopes of the observation focus on the hazards that might occur during the activities being conducted and any other potential hazards that might exist in the laboratories.

IV. Risk Assessment

Assessing potential hazards and risks will lead to the ability of describing both the likelihood of the event and the consequence [5]. The assessment is the process of quantifying the level of risk associated with the activities or operations [3]. The identified hazards will be rated in two terms; likelihood and severity. Likelihood indicates the number of event's occurrence in certain time. It is assessed based on the experience, analysis and measurement. Likelihood (L) levels range from "most likely" to "inconceivable." Table 1 explains the classifications of each level and their ratings.

TABLE 1
LIKELIHOOD (L) AND CLASSIFICATION

Likelihood (L)	Classification	Rating
Most likely	High chance to occur at any time	5
Possible	Has chance to occur and not unusual	4
Conceivable	Possible to occur sometimes	3
Remote	Has not been known to occur for long time	2
Inconceivable	Impossible or never occured	1

Severity (S) indicates the level of effects on health, environment or equipments. As likelihood, Severity also being rated as shown in Table 2:

TABLE 2
SEVERITY (S) CLASSIFICATION

Severity (S)	Classification	Rating
Catastrophic	Numerous fatalities, irrecoverable property damage	5
Fatal	Approximately one single fatality, major property damage	4
Serious	Non-fatal injury, permanent disability	3
Minor	Disabling but not permanent injury	2
Negligible	Minor abrasions, bruises, cuts, first aid type injury	1

For every activity, the hazards' L and S ratings decided from Table 1 and 2 are used to determine Risk (R). Qualitatively, R is calculated as follows:

$$\text{Risk, R} = \text{Severity x Likelihood} = \text{S x L} \quad (1)$$

The Risk,R obtained then are compared with Table 3 to determine the risk level whether it can be categorized as 'high', 'Medium' or 'Low' risk level. These level help laboratories personnel to assign logical priorities or actions towards hazards prevention.

TABLE 3
RISK MATRIX

	Severity (S)				
Likelihood (L)	1	2	3	4	5
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5

Risk Level: 15-25 = High
5-14 = Medium
1- 4 = Low

At the time the laboratories been observed, some of them are being occupied by students. Several short questions have been asked to the students regarding their workplace safety and safety procedures in the laboratories. The results obtained are used to validate the risk level obtained by the authors' assessment.

V. Results and Discussion

The risk levels are documented based on types of hazards and the laboratories classification as shown in Table 4. Overall risks level per classification is obtained by taking average of all hazards involved.

TABLE 4
LABORATORIES CLASSIFICATION AND HAZARDS' RISK LEVEL

Laboratories Classification	Hazard's Risk Rating					
	Ergonomic	Electrical	Mechanical	Air Contaminants	Chemical	Safety
Electrical & Electronics	6	11.4	5.4	4.8	3.4	5.6
Computer & Software	5.5	7.8	0	1	0	5.5
Mechanical & Process	5	7.9	7.3	8.4	5.7	7.1
Material & Sciences	3.7	3.7	6.37	7.37	10.2	5.7

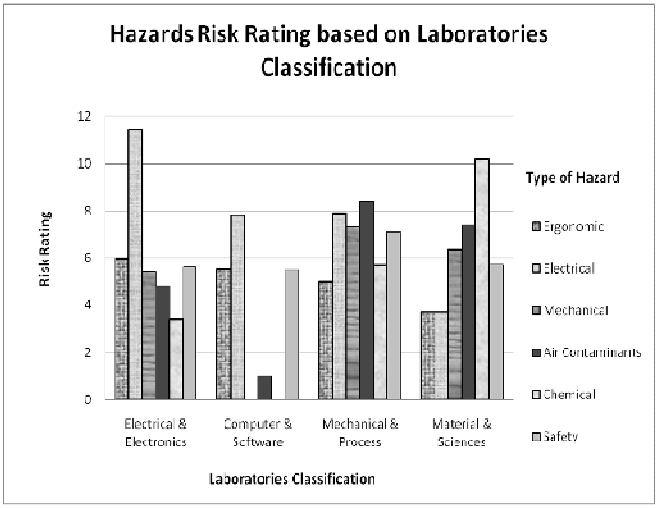


Fig. 2. Hazards Risk Rating based on Laboratories Classification

Fig. 2 shows the graph of hazards ratings based on four different laboratories. It is observed that in general every lab has all hazards regardless of the risk levels.

Electrics and electronics laboratories have ergonomics issues where most of the activities in the lab require static postures and activities. Students need to stand for a period of time to complete the task given. This is one of the main factor why the value of ergonomics hazards were counted to the value of 6.

Meanwhile, students in computer and software labs normaly sit on the chairs facing to the Personal Computer (PC). This result mainly due to static postures and potential repetitive strain injuries, dehydration, eye strain and lost focus. Sitting for a long period of time facing the PCs will also lead to ergonomics issues.

Chemical hazards are identified low even in chemical lab- the level of hazard is mainly high and the frequency of occurences are low due to students and staff practice safe work procedures. This hazard was not identified in electrics, electronics and software laboratories due to the activities in the respected lab are not much related with chemical waste but mainly deal with PCs and electrical devices.

The level of risk for mechanical hazard is high even though in mechanical hazard is mainly because of most of the machineries in the laboratories are powered by electricity and sometimes the operational practices are dangerous. This is the reason why the electrical hazards are commonly found and stated as high in those laboratories.

TABLE 5
OVERALL RISK LEVEL FOR EACH CLASSIFICATION

Laboratories Classification	Overall Risk Rating/Level
Electrical & Electronics	6.1 (Medium)
Computer & Software	3.3 (Low)
Mechanical & Process	7 (Medium)
Material & Sciences	6.2 (Medium)

In general, Table 5 shows the overall data of 4 categories of laboratories. Most of the laboratories are exposed with mechanical and process types of hazard. The average risk level under the scope of mechanical and process is 7 out of 25 which is considered as medium which needs to be highlighted and solved soon, but the urgency is still under a tolerable condition.

Fig. 3. Potential Hazards on using portable machineries

Fig.4. Potential Hazards of rotating abrasive wheel

Fig.5. Poor methods for maintenance

Fig.6. Inappropriate equipment storage

VI RECOMMENDATIONS

By right, the overall risk level at the selected UniMAP's laboratories can be classified to be at low level. The safe work procedures being practised by all laboratories' management seems effective for now. Based on the discussion, there are several recommendations on improvements that can be made in order to maintain or lower the current risk level:

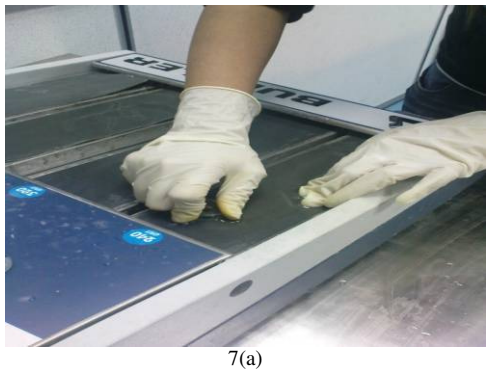
1. *Enforce or stricken the safety procedures in the laboratories* – As shown if Fig. 7(a) & (b), Only students with complete personal protective equipments are allowed to enter the laboratories.

2. *All equipments need continuous maintenance* – for time being, there is no preventive maintenance practice applied by most engineering school. The purpose of preventive maintenance is to increase the equipment reliability and life, also to prevent accidents happens due to equipments' failure.

3. *Provide adequate/larger laboratories* – the number of students is increasing each year. There will be crowded laboratories and limited spaces if there are not enough laboratories provided. For time being, Classes rotation being practiced is the best way to overcome this problem. Proper machine guarding as in Fig. 8 could prevent accidents in confined laboratories.

4. *Improve the equipments or device storage system* – An efficient storage system not only for the ease of future use but also for safety reasons. Inappropriate e storage of devices or equipments as in Fig. 6 will lead to accidents.

5. *Increase the management commitment* - Laboratories personnel should show their concern about safety by increasing supervision on work done by students. They can also practise safety and health programs in their own laboratories.



7(a)

7(b)

Fig 7 (a) &(b) Safe Work Procedure at different workplaces

Fig. 8. A sample of an appropriate machine guarding

VII CONCLUSION

In conclusion, it is understood that the average risk level at most of the laboratories at UniMAP is 5.65 which is in fact at medium level. However, since the value is really close to 5.0, the value of the risk level is considerably low. The range of the risk level for this study is 3.3 which is the difference between the highest value (mechanical laboratories) and the lowest (computer laboratories), showing that the divergence of the data is not significant. However, it is strongly recommended that some preventive actions to be taken in order to reduce the risk level in future.

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