HAZARD IDENTIFICATION, RISK ASSESSMENT AND RISK CONTROL APPLICATION (A – HIRARC) FOR CIVIL ENGINEERING LABORATORIES

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ABSTRACT

The development of technology based on the development of applications is increasing. Most laboratory assistants at Polytechnic Ungku Omar are required to fill out and print Hazard Identification, Risk Assessment, and Risk Control reports using traditional methods. The Hazard Identification, Risk Assessment and Risk Control (A-HIRARC) application benefits lab assistants and all supervisors on construction sites. The main objective of this research is to design application functions for hazard identification reports, risk assessment and risk control and to create applications for hazard identification reports, risk assessment and risk control using the Internet of Things (IoT) such as Canva and MIT applications and validate the application of the program with an expert. The assessment of this application was validated by 11 experts, including contractors, laboratory assistants, engineers and technicians. The results of this study show that professionals have a moderate mean interpretation of between 2.75 and 3.1 for all questions. This A-HIRARC app makes it easy for all users to understand all data and do better work. App users can also periodically review the reported data. The development of this application is based on OHSAS 18001 (2007), Occupational Health and Safety Test Series and Safety Management System requirements.

1. Introduction

The Hazard Identification, Risk Assessment and Risk Control (A-HIRARC) programme is important in handling received reports of accidents, conserving report data, and excessive report costs (DOSH 2008; Shuaib et al. 2021; Wahab et al. 2021). The influence of various Internet of Things (IoT) and Industrial Revolution 4.0 (I.R 4.0) element combinations on the performance of the proposed model has been investigated, and the efficacy of A-HIRARC has been emphasised (Lam et al. 2017; Xenofontos et al. 2021). A-HIRARC could manage and

solving the problem due to the implementation of IoT for hazard identification and risk assessment in the academic laboratory (Mustafa et al. 2021; Zaman et al. 2023). The goal of this research was to look into the Internet of Things (IoT) as well as the Industrial Revolution 4.0 (I.R. 4.0) in modelling application systems and give an alternative model for reporting accidents in IoT-based mobile apps (Chandanshive & Kazi 2017; Miorandi et al. 2012; Rajendran, Sathyanarayanan & John 2009). A-HIRARC received positive feedback according to the data survey results, and it had great functionality and also helped to solve the problem statements according to the objectives of developing A-HIRARC.

2. Materials and Methods

Canva Design, Firebase, and MIT App Inventor have become benchmark IoT software implementation methods for the A-HIRARC. To ease community challenges at the Civil Engineering Laboratory at Polytechnic Ungku Omar, the implementation is shown in Figure 1.

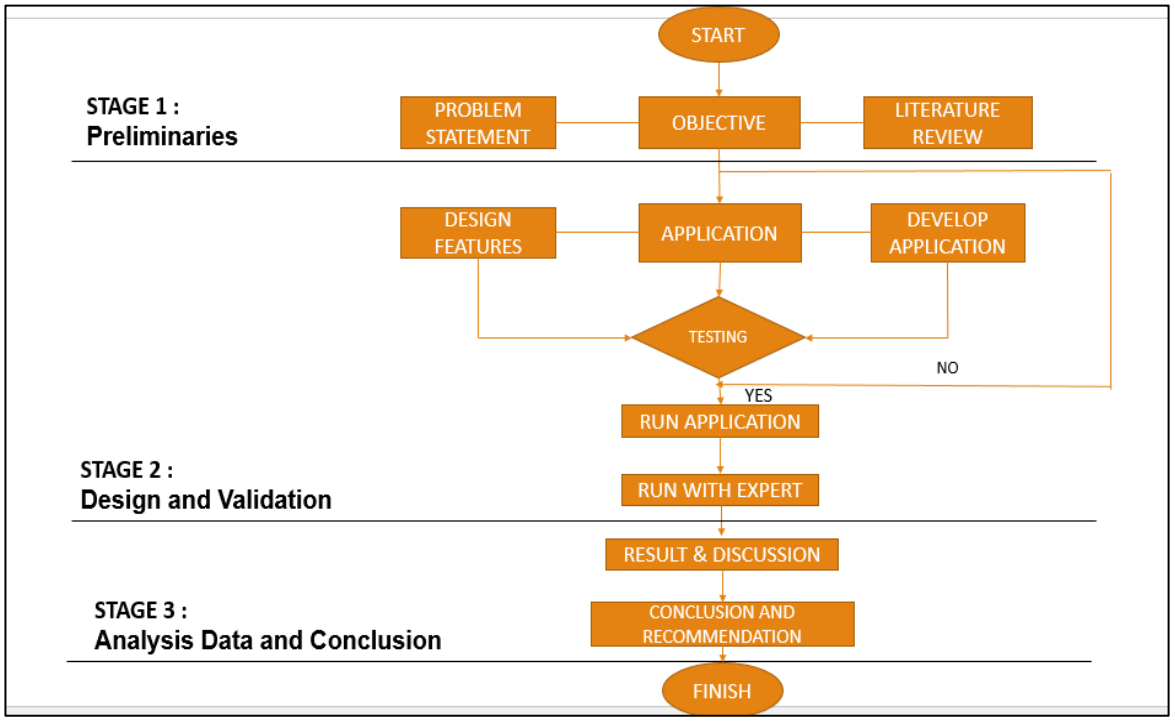


Figure 1: A Project Framework

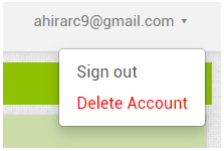
2.1 Designing Applications of HIRARC

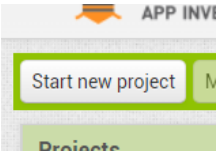
Table 1 shows the steps created for the app using the MIT app inverter. MIT app inverter is used to create all of the features in the safety management report or HIRARC, such as digital reports, guidelines, and maintenance schedules.

Table 1: Application Process

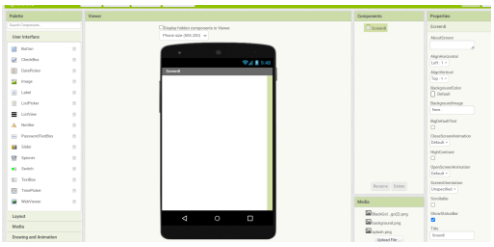
1. The researcher started by going to the MIT app inverter and clicking 'start building apps with App inverter 2" to go directly to designing and building apps

2. Next, the researcher signed up for the website using Facebook, Twitter, or email. The researcher has selected "start a new project".

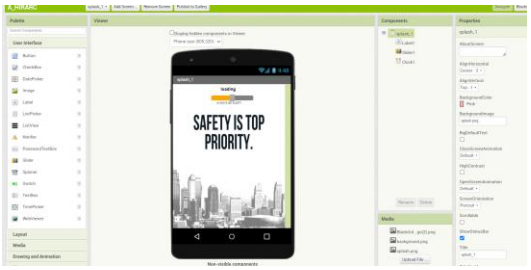




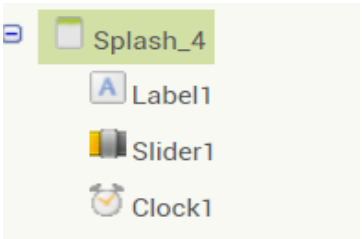
3. Following that, a blank page will show on the researcher's screen because the researcher has not added any features to the HIRARC. A user interface is shown on the left side of the screen, assisting the user in inserting the features that have been included in an app.



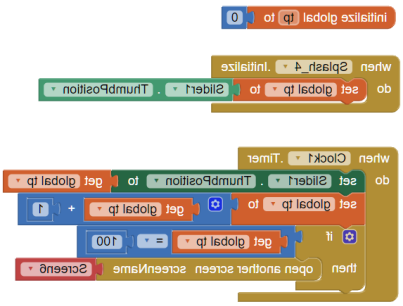
4. The splash screen has been used for the first screen. It can be used to promote a service or product or to announce a promotion before a user enters the site and views the rest of the tabs.



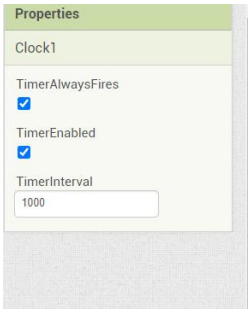
5. The researcher has selected the label in the user interface to build the name of the app and the space between the words that will be included in the apps on this splash page. After finishing editing the label features such as the text font, height, width, and text name also inserted other features like a clock and the slider to make the app function correctly.



6. After finishing the app page design, the researcher moved to the block to code the A-HIRARC app.

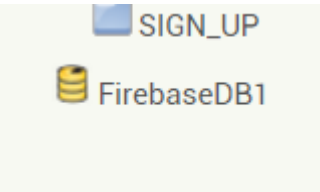


7. Then, the researcher modified the "Timer Interval from 100 to 1 at the clock's settings. The function of the feature is to initial the page.

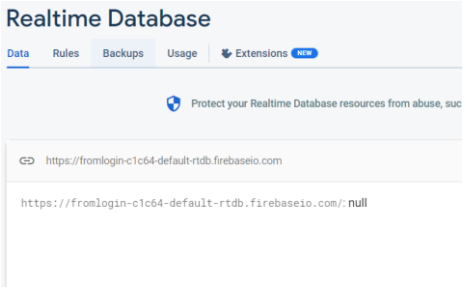


8. The following page has a sign-in and log-in page. The page makes use of user interface elements such as an image, a button, a label, a password text ox, and a text box. The researchers are then applying "Horizontal and Vertical Arrangement" to present a collection of components that are arranged from left to right and otherwise.

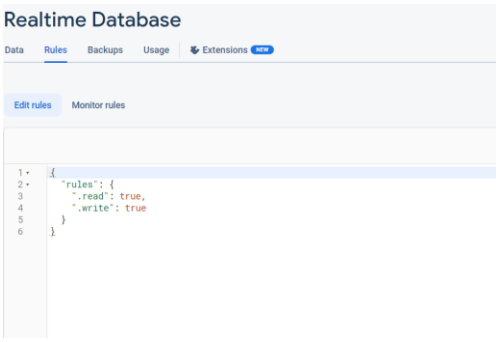
9. The researchers, on the other hand, have been building Firebase to manage data collection in the applications to collect all of the A-HIRARC user data. After clicking the experimental and dragging the Firebase into the "VIEWER" the researcher has been moved the http://firebase.google.com/ to start creating the app database



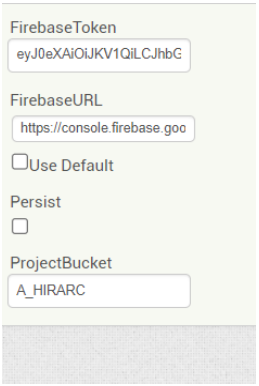
10. After finishing signing up with Firebase, the name of the project has been created and A-HIRARC "Real-time Database" on the left side of the screen has been clicked to bring up the online database collector that the researcher needs.



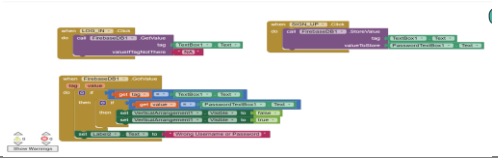
11. in the "Edit Rule" section, the code has been changed from false to true. The publish button was then clicked to apply the modified code. The Firebase URL has been copied on the "Data" page.



12. At the MIT app inverter, the Firebase URL was pasted to ensure that the user's data is captured and secure in the web base (Firebase)



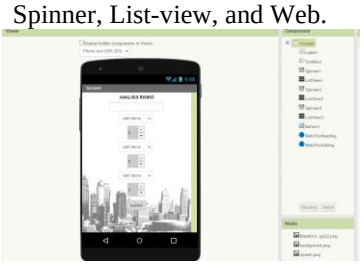
13. This is the block that appears once the app's code is completed. The researcher can choose which page will show after that one. For example, type "Open Another Screen" and then select a screen by entering "screen" on the keyboard.



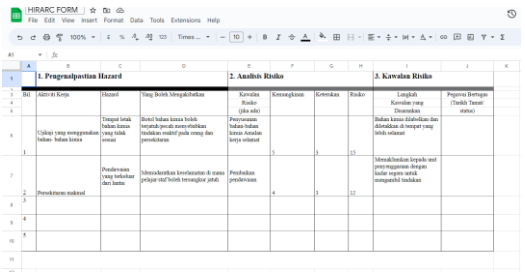
14. The researcher creates 4 app button functionalities for the "Main Page".

15. To navigate to another screen, the researcher typed "Open Another Screen" and then selected a screen by clicking "screen" on the computer. In addition, the researcher included a back button to access the previous page.

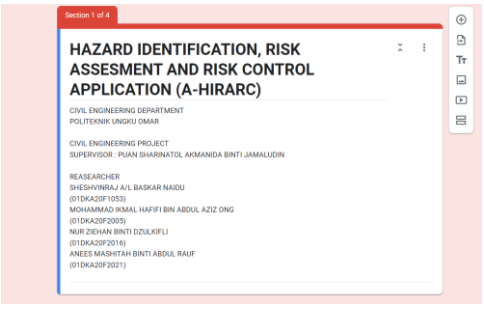
16. After finishing the "Main Page" the researcher started with the Report Form which is one of the features in the Hazard Identification, Risk Assessment, and Risk Control Application or A-HIRARC. On this page, the user interface that is used is the Label, Button, Spinner, List-view, and Web.



17. After finishing designing the page layout, the researcher moved to Excel and under "Tools", created a form has been clicked



18. Following that, the researcher began updating the form by filling in all the questions on Hazard safety by the expert.



2.2 Testing

When the download was complete and the A-HIRARC logo was displayed, the user clicked the created account/log-in button to start the process in this software. After completing the login process or creating a new account, the user can access the main page which contains buttons for form, files, history, and logout. By simply clicking the button on the form, users could also create new reports, which they could then fill out and paste into existing files. Users can find reports created and referenced by them by clicking on the files button. The history button feature allows users to search for deleted reports or reference reports that

were filled in incorrectly or deleted. The user can log out of their account after the report is complete so that other people can log in and use it.

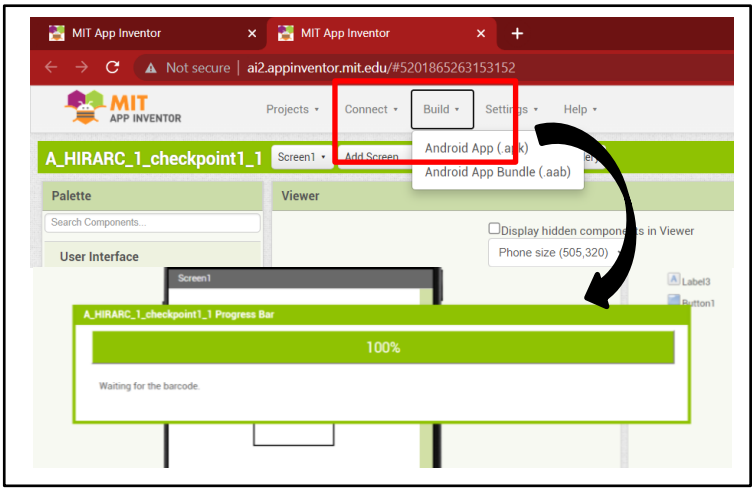


Figure 2: Testing procedure

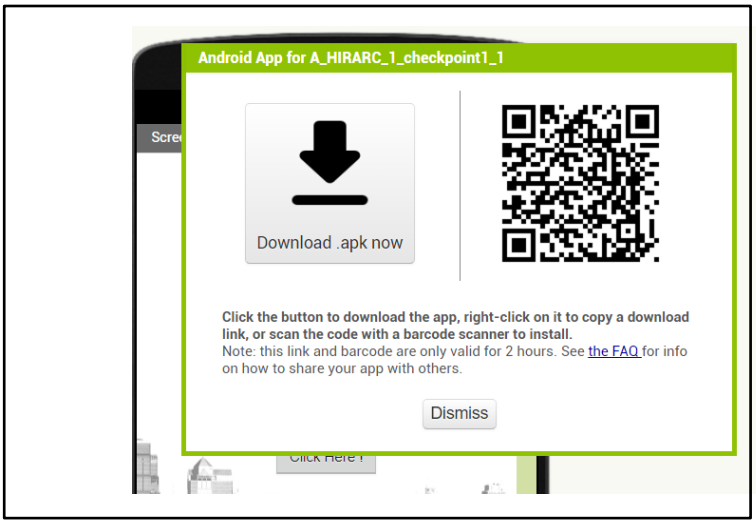


Figure 3: QR Testing

2.3 A-HIRARC Application Interface

Figure 4 shows the final result of the application after running as .apk on Android or iPhone.

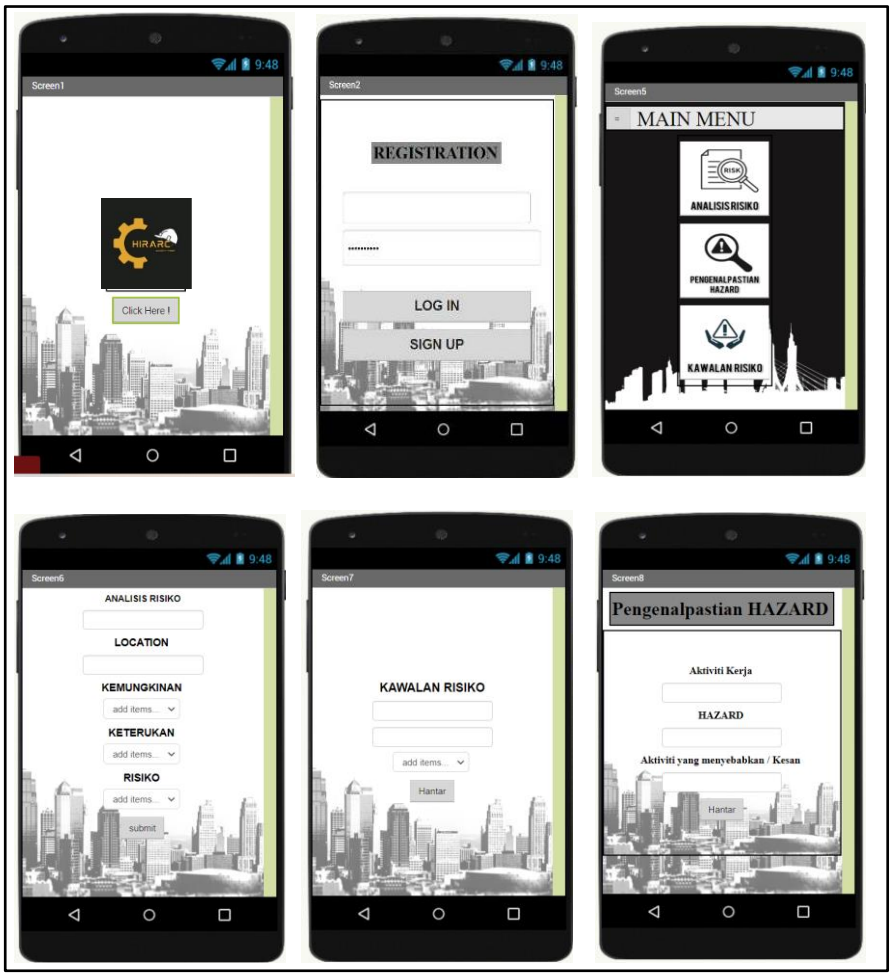


Figure 4: The final interface of Hazard Identification Risk Assessment and Risk Control Application (A – HIRARC)

3. Results

The information has been collected from 11 experts and has been analysed to obtain information such as mean, percentage, and standard deviation. The survey result was related to the data analysis process; the survey result was collected using a Google form to make it easy for an expert to provide ideas and to make it easy to collect data (Colson & Cooke 2017).

3.1 Expert Validation Respond

Data analysis of validation has been done for demographic and user satisfaction as shown in Table 2. This survey has been completed by 11 people. Male experts account for 72.7% of the total (8), while female experts account for 27.3% (3). According to Table 2, the Engineer position had 36.4% (4). The technician position comes with 27.3% (3). Furthermore, the lab assistant and contractor come with 18.2 (2).

Table 2: Summary of Demographic Info

Demographic	Sub-profile	Frequency	%
Gender	Male	8	72.7%
	Female	3	27.3
Age	Below 25 years	0	0%
	26-35 years	5	45.5%
	36-45 years	2	18.2%
	46-55 years	4	36.4%
	56-65 years	0	0%
	66 years above	0	0%
Position	Engineer	4	36.4%
	Technician	3	27.3%
	Laboratory Assistant	2	18.2%
	Contractor	2	18.2%
Experience	Below 5 year	1	9.1%
	6-10 years	5	45.5%
	11-15 years	2	18.2%
	16-20 years	2	18.2%
	Above 20 years	1	9.1%

The result was recorded by Mean, Standard Deviation, and Interpretation as shown in Table 3. In analysing the questionnaire, the source from Pallant (2020) was used for mean interpretation.

Table 3: Mean interpretation

Mean Value	Interpretation
1.00-1.66	**Low**
1.67-3.33	**High**
3.34-5.00	**Medium**

Source: Pallant (2020)

Result from Table 4 for Question 1, which is A HIRARC application provides a straightforward method for reporting any accident, hazard, or risk only one expert strongly disagrees (9.1%), three experts agree (27.3%) and seven votes strongly agree (63.6%). Next for question 2, A HIRARC Application that is simple to use and manages two votes for disagree and agree (18.2%) but seven experts vote for strongly agree (63.6%) for this question. Question 3, A HIRARC Application is convenient and paperless vote disagree is two experts (18.2%), one for agree (9.1%) and eight experts click for strongly agree (72.7%).

Table 4: Result Interpretation

No	Statement	SD	D	A	SA	MEAN	SD	Interpretation
Q1	A HIRARC Application provides a straightforward method for reporting any accident, hazard, or risk.	1 (9.1%)	0 (0%)	3 (27.3%)	7 (63.6%)	2.75	2.7	Moderate
Q2	A HIRARC Application that is simple to use and manage	0 (0%)	2 (18.2%)	2 (18.2%)	7 (63.6%)	2.75	2.6	Moderate
Q3	A HIRARC Application is convenient and paperless.	0 (0%)	2 (18.2%)	1 (9.1%)	8 (72.7%)	2.75	3.1	High
Q4	A HIRARC Application facilitates the department in recording all reports.	0 (0%)	2 (18.2%)	3 (27.3%)	6 (54.5%)	2.75	2.2	Moderate
Q5	A HIRARC Application interface and buttons are convenient.	1 (9.1%)	1 (9.1%)	5 (45.5%)	4 (36.4%)	2.75	1.8	Low

Furthermore, Question 4, which is A HIRARC Application facilitates the department in recording all reports two for disagree (18.2%), three for agree (27.3%) and six for strongly agree (54.5%). Lastly, for Question 5, A HIRARC Application interface and buttons are convenient there is one vote for strongly disagree and disagree (9.1%), five for agree (45.5%) and four experts vote for strongly agree (36.4%).

4. Discussion

A-HIRARC had been approved as capable of managing and solving problems due to the implementation of IoT for hazard identification and risk assessment in the academic laboratory. This study also demonstrated the research framework, research development, data collection, process of production and testing, system development of A HIRARC using MIT, and data analysis process that showed how and step of design for A HIRARC from the beginning, why A HIRARC had been developed, the tools that had assisted the researcher in designing and developing to make A HIRARC a reality to the user. In addition, it had been highly emphasized that the data from the expert validation obtained from the questionnaires showed that A-

HIRARC had received positive feedback according to the data survey results, and it had great functionality also helped to solve the problems statements and according to the objectives of developing A HIRARC at the beginning of the process for developing. In the future, a simple, fast, low-cost, and efficient risk assessment will be required to assist academic laboratories in further enhancing laboratory risk management. It might be necessary to combine qualitative and quantitative risk assessment techniques to improve the process while maximizing the benefits of each method. To effectively communicate the danger to laboratory users and prevent or reduce accident incidents in the academic laboratory, an online risk assessment might be required.

5. Conclusion

The Hazard Identification, Risk Assessment, and Risk Control Application (HIRARC) applications offer the programs a straightforward and immediate user interface and easier to conduct the HIRARC reporting and any other HIRARC-related works and maintenance. To mitigate hazards that potentially risk others and achieve the aim of becoming the greatest application, the safety officers and the maintenance departments should acknowledge A-HIRARC as a technology that will assist users in swiftly reporting any maintenance and hazards found. Designing (A-HIRARC) requires a thorough understanding of the application and product accumulation concepts. It is evident from the findings and discussions that the A-HIRARC system was properly built for this project. Several methods were used in this project to construct this application. Researchers employ a limited number of programs to create A-HIRARC, including the MIT app, Canva, and Firebase. This software was used to ensure the A-HIRARC was created following user needs. In the future, a simple, fast, low-cost, and efficient risk assessment will be required to assist academic laboratories in further enhancing laboratory risk management. It might be necessary to combine qualitative and quantitative risk assessment techniques to improve the process while maximizing the benefits of each method (Alaloul, Liew, and Zawawi 2015). To effectively communicate the danger to laboratory users and prevent or reduce accident incidents in the academic laboratory, an online risk assessment might be required.

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