Development of a Risk Analysis Application for Higher Education Institutions Using the Hazard Identification, Risk Assessment, and Risk Control (HIRARC) Methodology

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Abstract - In general, higher education institutions in Indonesia continue to face challenges in accurately mapping risks identified through Internal Quality Audits (IQA), resulting in limited collective management awareness of risk-based operations. Specifically, this study highlights that similar conditions persist in Cikarang, West Java, where risk identification and control processes remain insufficiently integrated into institutional quality improvement strategies. Although routine audit findings are successfully collected, the subsequent follow-up process is often unstructured and fails to prioritize the most crucial improvements. This research addresses these challenges by developing an application. Digital system adapted from the Hazard Identification, Risk Assessment, and Risk Control (HIRARC) methodology. That enables managers to collaboratively determine the risk level associated with each finding. The system also facilitates the categorization of findings based on the urgency of required corrective actions and prioritization for subsequent mitigation efforts. This application is designed to facilitate the conversion of every evaluation finding into a measurable risk score. The primary objective of this system is to deliver comprehensive visualization and mapping of risks through a collaborative process, enabling groups to identify the impact of each finding, conduct analysis and discussion to determine probability, exposure, and consequence, and classify the results into categories of very high risk, high risk, substantial risk, moderate risk, or low risk.

Keywords: Application, Risk Analysis, HIRARC, Higher Education Institution.

I. INTRODUCTION

Higher education institutions face market volatility, uncertainty, and complexity that demand the effective implementation of Enterprise Risk Management (ERM) to address both internal and external challenges while minimizing the loss of strategic opportunities [1]. In the context of universities, these risks encompass various aspects, including non-compliance with academic standards, declining stakeholder satisfaction indices, and potential reputational damage. Although universities strive to manage these risks through regular Internal Quality Audits (IQA) as a control mechanism, the process often only identifies the symptoms of underlying issues. [13] The Internal Quality Assurance System (IQAS) of higher education institutions carries a strategic responsibility in achieving the institution's mission and vision, particularly in supporting continuous quality improvement to sustain the quality of higher education services [2]. The main challenge faced by administrators lies in accurately mapping the risks identified from evaluation findings and prioritizing corrective actions to be implemented first. Consequently, the corrective measures taken often become ineffective and misaligned with actual institutional needs [3].

The gap between audit findings and the corrective actions taken arises from the lack of structured risk analysis integration among all parties involved in the process. Manual follow-up procedures often fail to prioritize the most critical improvements, ultimately contributing to a low level of collective risk-based awareness among administrators [4]. A framework is needed to measure how severe, how frequent, and how likely a finding is to recur—an approach that can be adopted from the HIRARC (Hazard Identification, Risk Assessment, and Risk Control) methodology [3]. To address these limitations and facilitate efficient and collaborative multi-factor analysis (Probability, Exposure, and Consequence), the integration of digital technology serves as a viable solution [5].

Therefore, this study aims to address the identified gap through the development of a Risk Analysis Application, a digital system based on the HIRARC methodology. The research was conducted at a private university located in Cikarang, West Java, Indonesia. The institutional audit covered various administrative, academic, and support units to evaluate organizational performance and ensure continuous quality improvement. The audited departments included the academic study programs, collaboration office, student affairs division, academic administration, finance and human resources departments, the Institute for Research and Community Service (LPPM), information systems division, Career Development Center (CDC), Independent Business Unit (UBM), Training Center (TC), Quality Assurance Office (LPM), and the marketing department. The audit is conducted once annually during the odd-semester break as part of the university's strategic work meeting, serving as a structured mechanism for institutional evaluation and enhancement.

Tabel 1. Internal Quality Audits (IQA) Department

No.	Department / Unit	Description
1	Study Programs	Academic units responsible for curriculum delivery and learning outcomes.
2	Collaboration Office	Manages institutional partnerships and external cooperation.
3	Student Affairs	Oversees student development, services, and campus life activities.
4	Academic Administration	Handles academic records, scheduling, and administrative processes.
5	Finance and Human Resources	Manages budgeting, financial operations, and staff administration.
6	LPPM (Institute for Research and Community Service)	Coordinates research activities and community engagement programs.
7	Information Systems Division	Maintains digital infrastructure and institutional information systems.
8	CDC (Career Development Center)	Provides career guidance, job placement, and industry linkage services.
9	UBM (Independent Business Unit)	Manages university-owned business and entrepreneurial initiatives.
10	TC (Training Center)	Develops and delivers training programs for internal and external stakeholders.
11	LPM (Quality Assurance Office)	Ensures continuous quality improvement and compliance with accreditation standards.
12	Marketing Department	Oversees branding, promotion, and student recruitment activities.

The application is designed to provide a platform for risk mapping in the form of collaborative events that can be jointly participated in. This enables collective risk mapping derived from each internal quality audit finding within higher education institutions. The goal is to enhance administrators' awareness of the significant impact that audit findings may have on the overall quality of educational services [1].

By converting findings into measurable risk scores, this application enables institutions to rationally prioritize which corrective solutions should be addressed first. This approach directs resource allocation toward the highest-risk areas and recommends more effective and sustainable corrective actions within the quality assurance system [5].

II. Research Methodology

HIRARC (Hazard Identification, Risk Assessment, and Risk Control) is a structured and highly effective risk management methodology, with its fundamental principles derived from global risk management standards such as ISO 31000 and ISO 45001 [8, 9]. This method operates through three main stages:

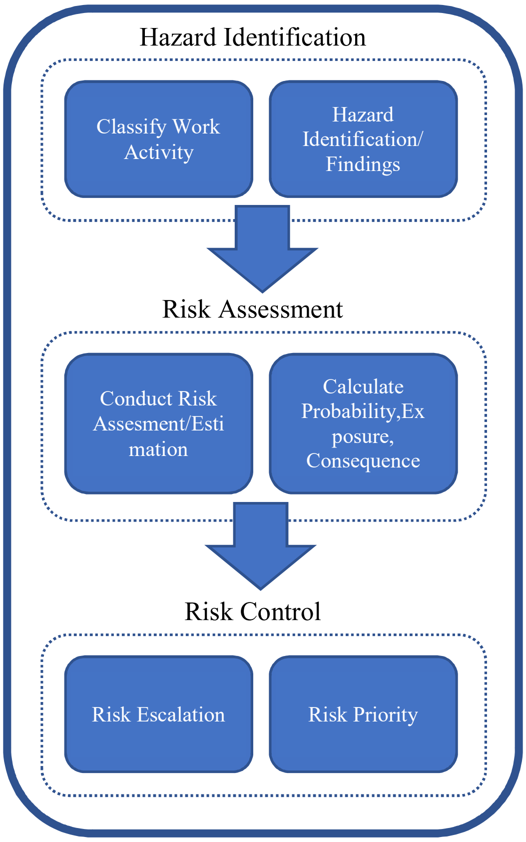


Figure 1. HIRARC Method ilustration

1. Hazard Identification: Recognizing all sources, situations, or actions that may cause harm, including risks related to academic quality or institutional

e-ISSN: 2614-8404
p-ISSN: 2776-3234

reputation [9].
2. Risk Assessment: Analyzing the severity level of risks, often using a semi-quantitative approach such as the formula: Probability × Exposure × Consequence to determine the risk score [9].
3. Risk Control: Establishing mitigation measures focused on eliminating or reducing risks through a hierarchical approach (from elimination to administrative control) [8].

This methodology will be digitalized within the application to assist administrators in rationally prioritizing which corrective solutions should be implemented first based on the identified risks.

A. Process Flow

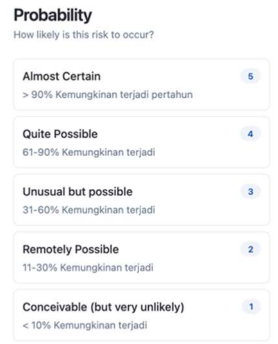
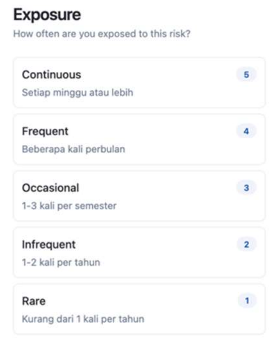
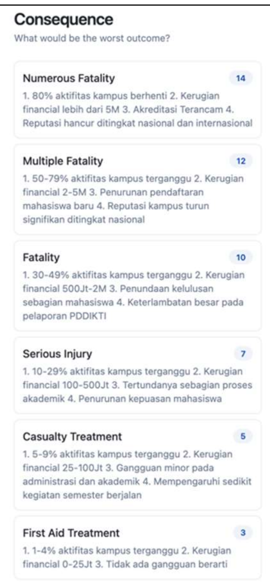
The process flow begins with hazard identification within the HIRARC framework, applied to quality-related risks in higher education institutions, followed by risk assessment and risk control [6].

1. The identification process briefly includes the following steps:
    1. Findings: Collection of *Internal Quality Audit (AMI)* data by compiling all audit findings from each unit or department within the institution.
    2. Risk Category: Developing several categories of potential negative impacts that may arise from identified risks.
    3. Risk: The identified hazards must be specific to the process being evaluated (e.g., *accreditation/external assessment, reputation, policy/SOP/regulation, operational, academic/administrative*), which will then serve as the primary input for the Risk Assessment stage within the application [7].

    This process is carried out by the administrator or event organizer of the risk analysis using the application.

2. Risk Assessment
    The risk assessment is conducted within the risk analysis application, implementing calculations that integrate probability, exposure, and consequence.
    A weighting process is also applied to adjust the influence of each variable on the overall score. In this study, the researcher applied weighting based on the consequence variable, meaning that the consequence indicator carries greater significance than the others [10].

Table 2. Risk Assessment Weighting

<table>
<tr><th>Risk Assessment</th><th>Description</th></tr>
<tr><td>
</td><td>Weighting is applied on a scale of 1–5, where a value of 5 represents the highest level for Almost Certain (with a probability of occurrence >90% per year), and a value of 1 represents the lowest level for Conceivable (with a probability of occurrence <10%).</td></tr>
<tr><td>
</td><td>Weighting is applied on a scale of 1–5, where a value of 5 represents the highest level for Continuous (occurring weekly), and a value of 1 represents the lowest level for Rare (occurring less than once per year).</td></tr>
<tr><td>
</td><td>Consequence weighting ranges from 3 to 14, where a value of 14 represents the highest level, indicating Numerous Fatalities or 80% of campus activities halted, financial losses exceeding 5 billion IDR, accreditation at risk, and severe reputational damage. A value of 3 represents the lowest level, indicating 1–4% of campus activities disrupted, financial losses between 0–25 million IDR, and no significant operational impact.</td></tr>
</table>

e-ISSN: 2614-8404
p-ISSN: 2776-3234

1. Risk Control
   After each finding is entered and calculated, the system generates a result based on the assigned weighting of variable X and the corresponding risk score criteria. The calculation process is automatically performed within the application by the user [11].

Tabel 3 Score Risk Result

Result	Score
Very high risk	>100
High risk	50-100
Substancial risk	20-49
Moderate risk	10-20
low risk	0-9

The table above presents the risk ranges derived from the application's calculation results, which combine findings, risk category, risk, and consequence. Using the HIRARC method, this combination produces a risk score, which is then classified into categories of very high risk, high risk, substantial risk, moderate risk, and low risk based on the scoring criteria shown in Table 2 [12].

B. Risk Analysis Application

The application development implements the principles and procedures of the HIRARC method [12]. The system also incorporates user roles and access rights, consisting of two main roles: admin and user. The admin has full access to all application features, including entering data (Identification), creating, deleting, or modifying events (Risk Assessment). Meanwhile, the user acts as a participant who performs risk mapping (Risk Assessment) and risk calculation based on the identified findings.
This approach aims to enhance management awareness of operational activities related to potential or existing risks (Risk Control).

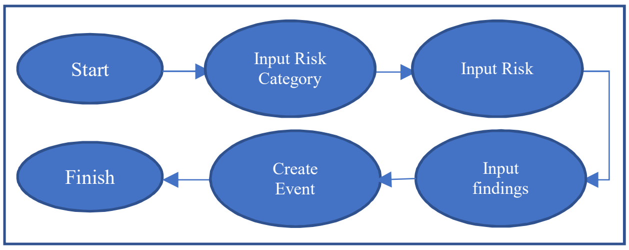


Figure 2. Admin Process Flow

The admin inputs the risk categories to assist users in identifying potential risks. Within each category, the admin specifies the corresponding risks. The admin then enters the findings obtained from the internal quality audit in the Findings tab. Finally, the admin creates an event that can be accessed by all participants to analyze the audit findings based on their associated risks.

1. Signup/Login

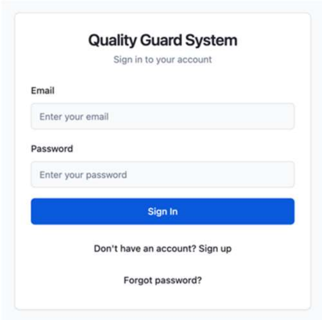


Figure 3. Authentication Page

The application can be accessed via https://takumikaizen.lovable.app. The figure above displays the login page of the system called Quality Guard System. On this page, users are prompted to enter their email and password to access their accounts. A blue "Sign In" button is provided for system access, along with additional links at the bottom for account registration (Sign Up) and password recovery (Forgot Password?). The interface design is simple and user-friendly, emphasizing ease of use during the authentication process.

2. Dashboard Page

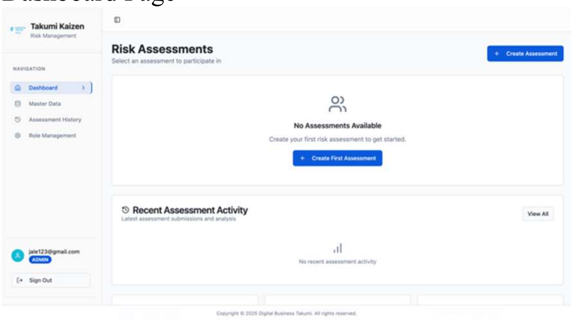


Figure 4. Dashboard Page

This interface presents a digital platform designed to perform and manage Risk Assessments in a centralized manner. The application features a navigation menu (Dashboard, Master Data, Assessment History, Role Management) and a primary "Create Assessment" button to initiate a new assessment process. Additionally, this page displays a history of previous assessments, which can be reopened when needed, allowing administrators to review and compare risk assessment results over time.

3. Identificaction
   a. Findings

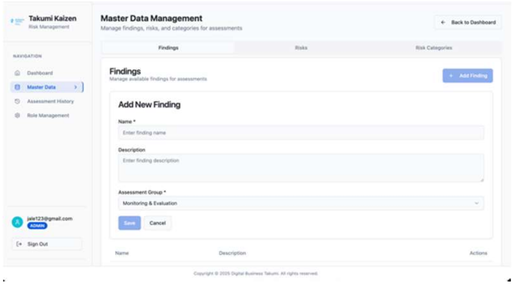


Figure 5. Findings Tab

This figure shows the "Findings" tab on the Master Data Management page. In this tab, the admin can add and manage findings for assessment purposes. A form labeled "Add New Finding" is provided, featuring fields for Name, Description, and Assessment Group (to categorize assessments), along with Save and Cancel buttons. At the top right, there is an "Add Findings" button to create new entries, and below it, an empty table designed to display the list of existing findings. By providing a centralized and categorized repository of findings, this tab ensures data consistency and efficiency across the entire Risk Assessment process.

b. Risk Category

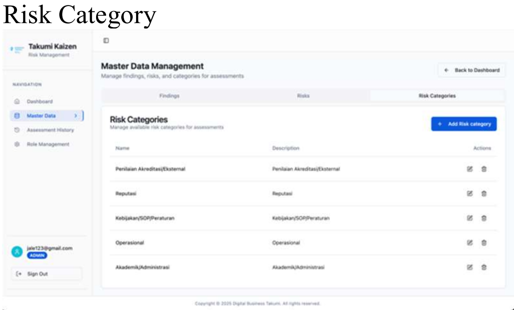


Figure 6. Risk Category Tab

The figure shows the "Risk Categories" tab within the Master Data Management module of the system. In this tab, users can add new risk categories by filling in the name, description, and selecting an assessment group. Save and Cancel buttons are available to manage the input process. The defined risk categories include Accreditation/External Assessment, Reputation, Policy/SOP/Operational Regulations, and Academic/Administrative. Categorizing risks at the outset ensures that all assessments remain aligned with the organization's key strategic areas.

c. Risk

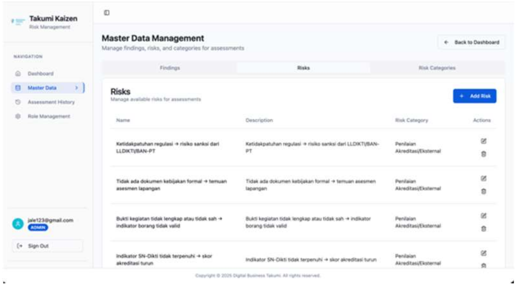


Figure 7. Risk Tab

The figure shows the "Risks" page within the Master Data module of the application. In this tab, users can add new risks by entering the name, description, and selecting both an Assessment Group and a Risk Category. Save and Cancel buttons are available to store or discard new entries. Each Risk is organized under a previously defined Risk Category, and the risk entries include descriptions that explain the potential impacts that may occur.

4. Create Assessment
This feature allows the initiation of an assessment event after the admin has entered the findings, risk categories, and risks.

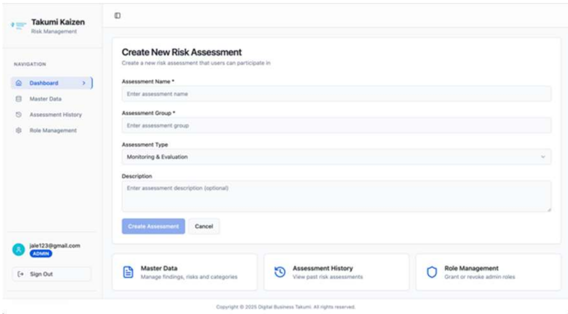


Figure 8. Create Assessment Page

The figure shows the "Create New Risk Assessment" page within the application. In this tab, the admin can create a new risk assessment by filling in the assessment name, assessment group, assessment type, and an optional description. Create Assessment and Cancel buttons are available to proceed with or cancel the creation process. Once the assessment is created by the admin, users can join the event to perform the next stage — the risk calculation process.

5. User Start Assessment (Risk Assessment)
Multiple users can participate in the risk assessment process simultaneously. These users may represent different departments, divisions, or units, allowing them to perform automated risk calculation and mapping through the application. This collaborative approach enables each manager to become more

e-ISSN: 2614-8404
p-ISSN: 2776-3234

aware of the risks related to their respective areas of responsibility, both directly and indirectly. Moreover, users can identify whether specific findings fall into high (very high risk/high risk), medium (substantial risk/moderate risk), or low (low risk) categories, allowing them to prioritize corrective actions based on risk levels. The following outlines the assessment workflow:

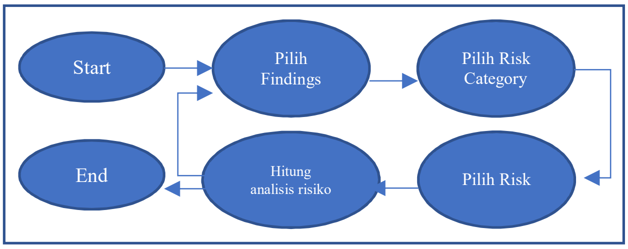


Figure 9. Assessment Flow

The user can start an event and then select a specific finding. Afterward, the user conducts an analysis by determining the category and potential risks associated with the selected finding. Next, a discussion is carried out to analyze the risk calculation, which consists of the combination of probability, exposure, and consequence. Once completed, the user proceeds to select the next finding to continue the assessment process.

a. User Start Assessment

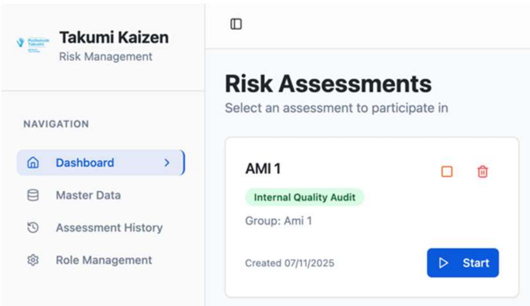


Figure 10. Risk Assessment

The figure shows the event assessment page created by the admin. Users can join the event by clicking the Start button on this page. The Start button directs the user to the Findings page, where they can proceed to the risk analysis process.

b. Select Finding

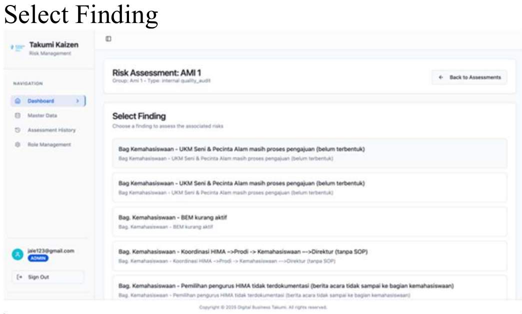


Figure 11. Risk Analysis Process

The figure shows the Select Findings process page. Users can select the findings previously entered by the admin, one at a time. This process represents the initial stage after starting the Risk Assessment. It serves as a crucial preliminary filter, ensuring that only findings relevant to the scope of the risk assessment are processed further.

c. Select Risk Category

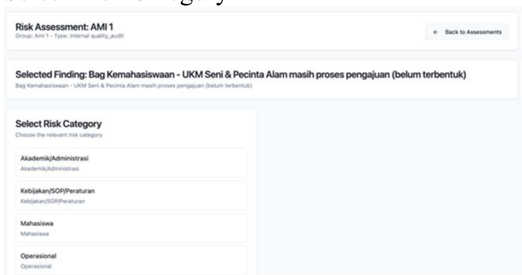


Figure 12. Selecting Risk Category

The figure illustrates the process following the user's selection of a finding. At this stage, the user analyzes the finding to determine the most appropriate risk category. This process helps map each finding according to its corresponding risk category, ensuring accurate classification for subsequent risk assessment.

d. Select Risk

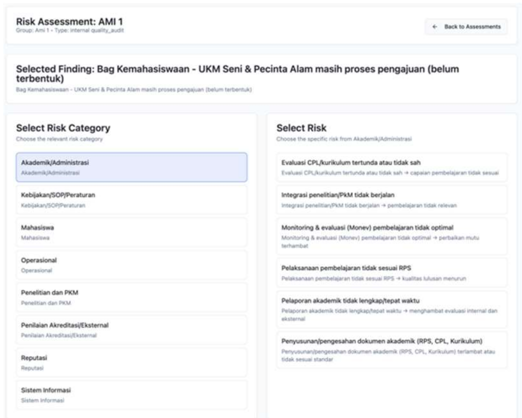


Figure 13. Selecting Risk

e-ISSN: 2614-8404
p-ISSN: 2776-3234

The Risk Assessment Page represents the core stage of the digital risk management system. The process begins by selecting Findings and grouping them into the appropriate Risk Categories. Based on these findings, users define the actual risks through causal analysis. This digital structure ensures collective and accurate risk identification, forming the foundation for effective measurement and prioritization of corrective actions. The accuracy of this mapping enables the system to automatically recommend the most critical corrective actions, addressing the common challenge of prioritization faced by management.

e. Risk Assessment Calculation and generate

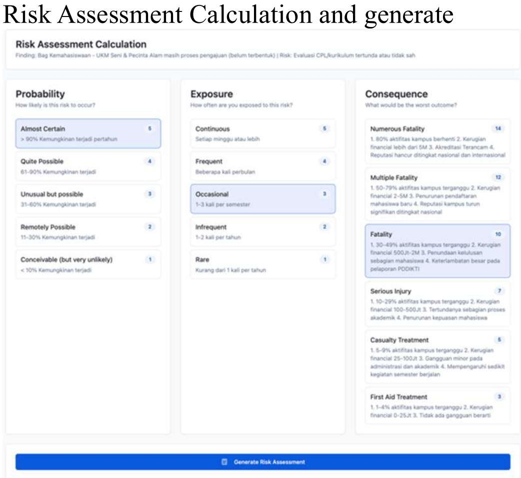


Figure 14. Calculation Risk

The figure shows the risk calculation page, which is based on the findings, risk categories, and risks defined in the previous stage. Users engage in discussion and analysis focusing on three key dimensions: probability, exposure, and consequence. This discussion forms the core of the qualitative assessment, where the team's experience and expertise are utilized to assign the most accurate values for each risk dimension.

After completing the qualitative analysis and discussion of these parameters, users select the corresponding risk option, which is then automatically calculated by the application. With the validated qualitative input, the system instantly and objectively computes the final risk score, directly determining the priority level of the required control actions.

f. Result

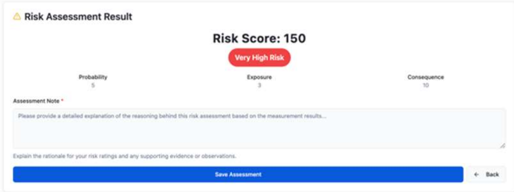


Figure 15 Generate Result

The figure illustrates the final stage of risk analysis, discussion, and calculation. At this point, the user can click the "Generate" button within the Risk Assessment Calculation and Generate process to instruct the application to compute results based on the predefined methodology and weighting system embedded in the application.

This section displays the final score and corresponding risk status — categorized as Very High Risk, High Risk, Substantial Risk, Moderate Risk, or Low Risk — according to the established range. Users are also required to input notes summarizing key points from the discussion and analysis before finalizing the calculation.

Once complete, the user can save the results by clicking "Save Assessment." Upon saving, the application automatically redirects the user back to the Findings page. This functionality enables users to continue selecting other findings and repeating the process until all findings have been collectively assessed through discussion and analysis.

This stage ultimately supports the goal of enhancing institutional awareness of potential risks identified during the Internal Quality Audit (AMI) and facilitates the prioritization of improvement actions within the university based on the assessed risk levels.

III. RESULTS AND DISCUSSION

From the risks that have been entered and calculated using the application, there are 82 findings distributed across seven categories: Academic, Policy/SOP, Student Affairs, Operational, Research and Community Service (PKM), Accreditation Assessment, and Information Systems.

The following table presents the collective results of the risk calculations performed using the system:

Tabel 4. Result

Result	Category	%	total %
Very High Risk	Academic	25%	12,2%
	Policy/SOP	25%	
	Student	12,5%	
	Operational	12,5%	
	Research and Community Service	12,5%	
	Study Program	12,5%	
	Information System	25%	
High Risk	Academic	14,3%	25,6%
	Policy/SOP	28,6%	
	Research and Community Service	42,9%	
	Study Program	4,8	
	Information System	9,5%	
Substancial Risk	Academic	38,6%	53,6%
	Policy/SOP	11,4%	
	Student	4,5%	
	Operational	4,5%	
	Research and PKM	31,8%	
	Accreditation Assessment	4,5%	
	Information System	4,5%	

The results indicate that 53.6% of the 82 findings fall under the substantial risk category, 25.6% are classified as high risk, and 12.2% are categorized as very high risk.

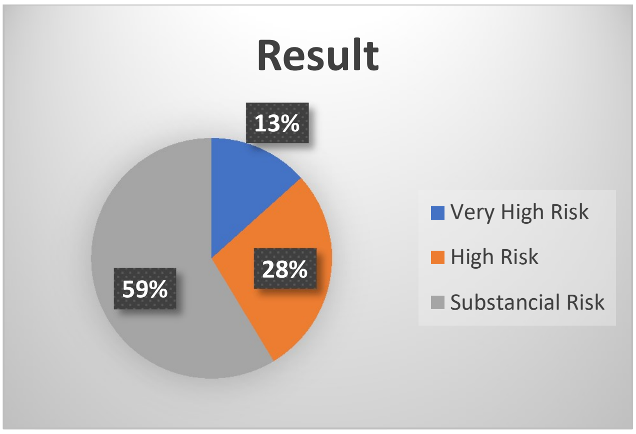


Figure 16. Result Chart

Based on the categorized results:

1. Substancial risk was primarily derived from the following categories
   - Academic 38,6%
   - Research and Community Service (RCS) 31,8%.
2. Hight Risk was primarily derived from the following categories
   - Research and Community Service (RCS) 42,9%
   - Policy/SOP 28,6%
3. Very High Risk was derived from the Academic, Policy/SOP, and Information System categories, each contributing equally with 25%.

From these results, it can be concluded that substantial risk is the most dominant category, accounting for more than 50% of the total findings. The academic and research/community service (RCS) areas become the primary focus for improvement. High risk ranks second at 28%, with the RCS category being the main target for corrective actions. Very high risk follows in third place with 12.2%, highlighting the academic, policy/SOP, and information system categories as key areas for improvement.

In other words, the academic and research/RCS categories are the most critical areas that require close attention. Based on these findings, management can map out detailed corrective actions according to the level of risk. All improvement efforts related to these areas should be prioritized to prevent recurrence in the future. Furthermore, these results serve as a foundation for developing institutional or unit-level work programs and operational plans within the university.

IV. Conclusion

This study illustrates the digitalization of the risk mapping and assessment process based on findings from the Internal Quality Audit (IQA) of higher education institutions. The developed application is designed to provide a platform for unit or institutional managers within universities to gain a comprehensive and collective understanding of risk-based institutional management improvement.

The HIRARC (Hazard Identification, Risk Assessment, and Risk Control) methodology integrated into the application supports this goal by employing a semi-quantitative approach, which requires active analysis and discussion to determine key risk variables. urthermore, this study raises awareness among university managers that operational activities that may appear routine or low-risk can, in fact, pose significant threats to the quality and integrity of higher education if not properly identified and managed. Future research is recommended to advance the exploration of digital risk control systems within the internal quality audit framework of higher education institutions. A particular emphasis should be placed on the development of information technology–based tools capable of conducting real-time monitoring and automated evaluation of improvement priorities identified through risk mapping results.

Subsequent studies could also investigate the integration of internal audit mechanisms with digital risk management dashboards that visualize dynamic Key

e-ISSN: 2614-8404
p-ISSN: 2776-3234

Performance Indicators (KPIs) and support data-driven decision-making. Furthermore, the application of machine learning and predictive analytics should be examined to detect recurring risk patterns that may be overlooked by traditional manual audits, thereby improving both the accuracy and responsiveness of the quality assurance cycle.

Comparative research among universities with varying levels of digital maturity is likewise encouraged to identify the critical success factors influencing the effective implementation of digital risk control systems. Through these investigations, future studies are expected to contribute to the enhancement of university governance and quality management by promoting technology-driven, efficient, and continuously improving audit processes.

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