



Evaluating Risks in an Outcome-Based Education Assessment Information System: A Qualitative Case Study in Higher Education

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Article Info

Article history:

Received Jan 19, 2026

Revised May 11, 2026

Accepted May 13, 2026

Online First Jun 12, 2026

Keywords:

Higher Education

Outcome-Based Education

PMBOK

Project Risk Management

Risk Analysis

ABSTRACT

Purpose of the study: This study aims to identify, categorize, and prioritize risks in an Outcome-Based Education (OBE)-based assessment information system related to learning outcome evaluation, Program Learning Outcomes–Course Learning Outcomes assessment processes, and institutional quality assurance implementation in higher education.

Methodology: This study used a qualitative case study approach with the Project Management Body of Knowledge® Guide Sixth Edition Project Risk Management framework, Risk Breakdown Structure (RBS), and qualitative probability–impact matrix. Data collection methods included document analysis, direct observation, semi-structured interviews, prototype system review, and Program Learning Outcomes–Course Learning Outcomes mapping validation.

Main Findings: Eighteen risks were identified across technical, data-related, operational, human resource, curriculum-related, and infrastructure categories. High-priority risks involved inconsistencies in Program Learning Outcomes–Course Learning Outcomes mapping and assessment weighting structures. Extreme risks included system integration limitations, developer dependency, and infrastructure readiness issues affecting learning outcome evaluation and assessment consistency.

Novelty/Originality of this study: This study presents a structured qualitative risk analysis framework for Outcome-Based Education (OBE)-based assessment information systems by integrating educational evaluation perspectives with project risk management approaches. The study highlights how organizational, operational, and data-related risks influence learning outcome assessment validity and institutional quality assurance processes.

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1. INTRODUCTION

Outcome-Based Education (OBE) has become a dominant paradigm in higher education as institutions are increasingly required to demonstrate measurable learning outcomes and accountability in academic quality assurance. In the Indonesian context, the implementation of Outcome-Based Education is not merely an academic preference but a national policy mandate. The Indonesian National Qualification Framework (Kerangka Kualifikasi Nasional Indonesia) establishes learning outcomes as the primary reference for defining graduate competence levels [1]. This mandate is further operationalized through the National Standards for Higher Education, which require systematic assessment and evaluation of learning outcomes as part of

institutional quality assurance mechanisms [2]. Moreover, the Regulation of the Ministry of Education, Culture, Research, and Technology No. 53 of 2023 reinforces the obligation of higher education institutions to implement outcome-based evaluation within an internal quality assurance system [3]. Consequently, Outcome-Based Education assessment systems constitute a mandatory institutional mechanism supporting accreditation and continuous improvement processes.

Although Outcome-Based Education has been widely adopted, its implementation—particularly in assessment systems—remains challenging. Prior studies emphasize that Outcome-Based Education implementation extends beyond pedagogical considerations and involves complex organizational processes, including curriculum alignment, assessment design, data governance, human resource readiness, institutional policies, and technological infrastructure [4]-[6]. Empirical studies in the Indonesian higher education context further indicate that inconsistencies in Program Learning Outcomes (PLO)–Course Learning Outcomes (CLO) mapping, fragmented assessment data, and reliance on manual procedures can undermine the validity and reliability of learning outcome evaluation [7], [8].

Recent educational assessment literature emphasizes that learning outcome evaluation should support not only measurement activities but also meaningful interpretation of assessment evidence for educational improvement and decision-making. Tai et al. define evaluative judgement as the capability to make decisions about the quality of work and highlight the importance of assessment systems in supporting valid interpretation of learning performance [9]. Studies on learning analytics in higher education further indicate that educational data and assessment systems increasingly influence educational decision-making, learning support, and institutional quality assurance processes [10], [11]. Data-based decision-making literature further emphasizes that educational data should support iterative improvement processes involving goal setting, evidence interpretation, action planning, and evaluation within educational organizations [12]. Recent systematic literature reviews further indicate that learning analytics systems in education provide substantial potential for improving learning monitoring and educational evaluation, although empirical evidence regarding their effectiveness in improving learning outcomes and assessment interpretation remains limited [11], [13]. In addition, authentic assessment practices are considered important for supporting competency development, academic integrity, and graduate employability [14]. These findings indicate that assessment systems should be examined not solely from a technological perspective, but also from the standpoint of educational evaluation validity, interpretation of assessment evidence, and assessment governance [15].

Assessment systems serve as the backbone of Outcome-Based Education implementation because they determine how accurately Program Learning Outcomes (PLOs) and Course Learning Outcomes (CLOs) are measured, interpreted, and utilized for educational quality improvement. Recent higher education literature further emphasizes that systems for designing and assessing learning outcomes play a central role in maintaining curriculum coherence and constructive alignment across academic programs [16]. However, the development and operation of Outcome-Based Education assessment information systems often involve multiple stakeholders, heterogeneous data sources, and evolving regulatory requirements, which increase system complexity and exposure to risk. Research has shown that the effectiveness of academic information systems and assessment practices is strongly influenced by organizational factors, data quality, and coordination mechanisms [17], [18]. These conditions indicate that Outcome-Based Education (OBE)-based assessment information systems are inherently vulnerable to risks that may compromise the validity, consistency, and interpretability of learning outcome evaluation. Such risks may reduce the reliability of assessment evidence used for curriculum improvement, accreditation processes, and academic decision-making. Recent studies on learning outcome assessment in higher education emphasize that assessment systems should support rational, interpretable, consistent, and institutionally accountable evaluation processes to ensure program quality, comparability of learning outcomes, and accreditation readiness across academic programs [19], [20]. Learning analytics literature also highlights that assessment information systems increasingly function as mechanisms for supporting educational decision-making and monitoring learning processes in higher education environments [10], [11].

Given the increasing complexity and risk exposure associated with Outcome-Based Education assessment information systems, the need for a structured and systematic approach to managing uncertainty becomes increasingly evident. Risk management has therefore emerged as a critical governance approach in higher education to address uncertainties that may affect academic quality and institutional performance. Existing studies consistently indicate that risks in higher education span academic, operational, strategic, and quality assurance dimensions, while also highlighting the limited integration of structured risk management frameworks within educational institutions [21]. Similarly, Jesry et al. [22] provide empirical evidence that integrating risk management into quality assurance systems enhances institutional capacity to anticipate disruptions and supports evidence-based decision-making. In the context of outcome-based learning, Rosiawan and Trisnawati [23] further show that risk management contributes to the effectiveness of learning outcome achievement, although existing studies predominantly focus on instructional processes rather than assessment systems. Collectively, these findings suggest that while the importance of risk management in higher education is increasingly recognized, its application remains fragmented and often reactive, particularly within academic

governance and assessment-related processes [24]. These challenges become increasingly significant as assessment systems are expected to provide credible evidence for evaluating student competency achievement and institutional educational quality [9], [14].

From an institutional perspective, assessment systems can be conceptualized as organized initiatives with defined objectives, resource constraints, and cross-functional coordination requirements. To systematically analyze uncertainties associated with Outcome-Based Education assessment information systems, project-based risk management principles provide a relevant analytical perspective. The Project Management Body of Knowledge conceptualizes project risk management as a systematic process encompassing risk identification, qualitative and quantitative risk analysis, and risk response planning [25]. Previous methodological studies have demonstrated that qualitative risk analysis is particularly suitable for complex and context-dependent initiatives, including organizational processes and information systems, where reliable probabilistic data are often unavailable [26], [27].

Empirical evidence from higher education institutions further indicates that risks related to data consistency, human resource capacity, operational procedures, and curriculum dynamics significantly influence the effectiveness of academic systems. In [28], it is emphasized that insufficient risk management within educational quality systems can weaken accreditation readiness and long-term institutional sustainability. Moreover, multiple studies consistently report that risk management practices in higher education tend to be reactive rather than proactive, especially in the governance of academic information systems and assessment processes [29], [30].

Despite the growing recognition of risk management in higher education, research that specifically focuses on risk analysis in Outcome-Based Education assessment information systems remains limited. Most existing studies address risk management at a general institutional level or focus on instructional and learning process risks, rather than on assessment systems as the core operational mechanism of Outcome-Based Education. Existing studies tend to address general institutional risks or instructional challenges, leaving assessment systems—especially those supporting the evaluation of Program Learning Outcomes and Course Learning Outcomes—relatively underexplored. Recent systematic reviews also indicate that factors influencing learning outcomes through learning analytics systems in higher education remain insufficiently understood, particularly regarding evaluation consistency and interpretation across institutional contexts [31], [32]. Existing literature has also paid limited attention to how risks within assessment information systems may influence the validity, consistency, and interpretability of learning outcome evaluation processes in higher education [9], [11]. In addition, empirical studies applying structured project-based risk management frameworks, such as the Project Management Body of Knowledge Guide, to analyze risks in Outcome-Based Education assessment information systems are still scarce, particularly within the regulatory-driven context of Indonesian higher education. This gap is critical because Outcome-Based Education assessment information systems represent the core mechanism through which Outcome-Based Education principles are operationalized and validated within higher education institutions.

Therefore, this study aims to conduct a qualitative risk analysis of an Outcome-Based Education assessment information system through a case study at the Faculty of Engineering, Universitas Tidar. By adopting the Project Risk Management framework from the Project Management Body of Knowledge Guide Sixth Edition, this study identifies and prioritizes risks associated with technical, data-related, operational, human resource, curriculum, and infrastructure aspects of the Outcome-Based Education assessment information system. The findings are expected to provide practical insights for higher education institutions in strengthening risk-informed governance and supporting more credible, consistent, and sustainable learning outcome evaluation and quality assurance practices in higher education.

2. RESEARCH METHOD

This section outlines the methodological procedures employed to conduct the risk analysis of the Outcome-Based Education (OBE)-based assessment information system at the Faculty of Engineering, Universitas Tidar.

2.1 Research Design

This study employed a qualitative research design using an exploratory case study approach. The study focused on an institutional case involving the implementation of an Outcome-Based Education assessment information system in higher education. Qualitative research is appropriate for exploring complex organizational and institutional phenomena, particularly when the objective is to identify and understand risks arising from processes, governance structures, and contextual factors rather than to test causal relationships quantitatively. The case study approach enables an in-depth examination of a contemporary phenomenon within its real-life context, where the boundaries between the phenomenon and its context are not clearly evident [33], [34]. This design provides a suitable methodological foundation for subsequent project-based risk analysis.

The case study design was selected because the development and implementation of an Outcome-Based Education (OBE)-based assessment information system in higher education involves multiple interrelated components, including academic policies, assessment procedures, data governance, system configuration, and coordination among stakeholders. These components interact dynamically and generate various types of risks that cannot be adequately captured through survey-based or experimental methods. By focusing on a single institutional case, this study aims to capture contextual risk characteristics and institutional conditions that influence the reliability and sustainability of the Outcome-Based Education (OBE)-based assessment information system, thereby enabling a detailed understanding of risk sources and their organizational context.

2.2 Research Object and Context

The object of this research was the Outcome-Based Education (OBE)-based assessment information system implemented to support learning outcome evaluation at the Faculty of Engineering, Universitas Tidar. The faculty has formally adopted Outcome-Based Education principles in response to national higher education regulations and accreditation requirements, which mandate systematic measurement and evaluation of learning outcomes at both program and course levels. As part of this implementation, assessment activities are supported by an Outcome-Based Education (OBE)-based assessment information system intended to facilitate the collection, integration, and utilization of Program Learning Outcome and Course Learning Outcome achievement data.

The Faculty of Engineering was selected as the research context because its Outcome-Based Education assessment implementation involves multiple academic programs, diverse assessment practices, and coordination across academic and administrative units. These conditions create a complex environment in which socio-technical risks—arising from the interaction between the assessment information system, organizational processes, human resources, curriculum dynamics, and governance mechanisms—may emerge. Therefore, the faculty represents a relevant and information-rich case for examining risks associated with the implementation of Outcome-Based Education (OBE)-based assessment information systems in higher education.

In this study, the Outcome-Based Education (OBE)-based assessment information system is positioned as an institutional mechanism that operationalizes learning outcome evaluation rather than merely a support tool. The focus of the research is on identifying and analyzing risks that may affect the effectiveness, reliability, sustainability, and governance readiness of the Outcome-Based Education (OBE)-based assessment information system, rather than evaluating system performance from a purely technical perspective.

2.3 Risk Management Framework

Risk analysis in this study was conducted using the Project Risk Management framework from the *Project Management Body of Knowledge (PMBOK®) Guide Sixth Edition*. According to Project Management Body of Knowledge, project risk management is a structured and systematic process that includes risk identification, risk analysis, and risk response planning to increase the likelihood of achieving project objectives [25]. This framework was adopted because the development and institutional implementation of an Outcome-Based Education (OBE)-based assessment information system can be conceptualized as an organizational initiative involving defined objectives, multiple stakeholders, limited resources, and cross-functional coordination.

Given the exploratory nature of the study and the absence of reliable quantitative risk data, this research focused on qualitative risk analysis as defined in the Project Management Body of Knowledge framework. Qualitative risk analysis enables the prioritization of risks based on their probability of occurrence and potential impact on objectives, making it suitable for complex organizational and information-system-related contexts in higher education [26]. The flexibility of the Project Management Body of Knowledge-based approach has also been demonstrated in various project settings to support systematic risk identification and qualitative assessment techniques, including probability–impact evaluation, across different organizational environments [35].

Following the Project Management Body of Knowledge® Guide Sixth Edition, qualitative risk analysis in this study employed a probability–impact matrix as an analytical technique to determine risk levels. Risk likelihood was assessed qualitatively using three categories (*improbable*, *possible*, and *probable*), while risk impact was evaluated using four categories (*acceptable*, *tolerable*, *undesirable*, and *intolerable*), adapted to reflect the institutional context of higher education. The combination of likelihood and impact ratings was used to classify risks into four levels: *low*, *medium*, *high*, and *extreme*, which served as the basis for risk prioritization and subsequent risk response planning [25].

In this study, the Project Management Body of Knowledge framework was applied to structure the identification and prioritization of risks associated with technical, data-related, human resource, operational, curriculum, and infrastructure aspects of the Outcome-Based Education (OBE)-based assessment information system. The framework provides a coherent basis for organizing risk information and guiding subsequent risk response planning within the institutional context of higher education. Figure 1 presents the research framework adopted in this study, illustrating the sequence of Project Management Body of Knowledge-aligned qualitative

risk management stages applied to the development and implementation of the Outcome-Based Education (OBE)-based assessment information system.

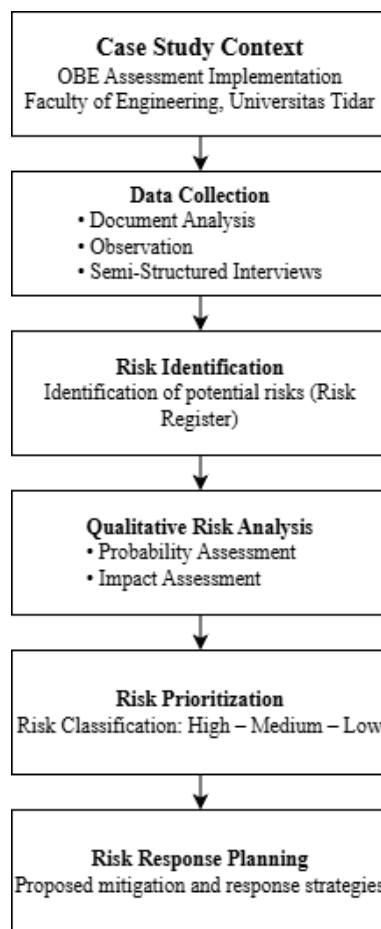


Figure 1. Research Framework for Qualitative Risk Analysis of the Outcome-Based Education (OBE)-Based Assessment Information System

2.4 Data Collection Techniques

Data were collected using multiple qualitative techniques to ensure triangulation and enhance the credibility of the findings. Each data collection technique was selected to support the identification and validation of potential risks associated with the implementation and operation of the Outcome-Based Education (OBE)-based assessment information system within the institutional context.

First, document analysis was conducted to review relevant institutional documents, including curriculum and assessment guidelines, Program Learning Outcomes–Course Learning Outcomes mapping documents, internal quality assurance reports, and project-related documentation associated with the development and use of the Outcome-Based Education (OBE)-based assessment information system. Document analysis primarily supported the identification of formal risk sources related to policies, procedures, data structures, and documented assessment practices.

Second, direct observation was carried out to examine assessment workflows, data management practices, and coordination mechanisms among academic and administrative units involved in operating the Outcome-Based Education (OBE)-based assessment information system. Observations were used to identify operational gaps and system-related practices that may not be fully captured in formal documentation.

Third, a limited number of semi-structured interviews were conducted with selected academic and administrative personnel responsible for assessment coordination, system operation, and academic quality assurance at the faculty level. Interviews focused on practical challenges and uncertainties encountered during the implementation and utilization of the Outcome-Based Education (OBE)-based assessment information system.

The research participants consisted of academic and administrative personnel directly involved in the implementation and operation of the Outcome-Based Education assessment information system at the Faculty of Engineering, Universitas Tidar. These participants included faculty-level academic quality assurance personnel, study program representatives, assessment coordinators, and system operational personnel. Participants were

selected purposively based on their roles, responsibilities, and experience related to learning outcome assessment processes and the utilization of the assessment information system.

The data collection instruments included document review sheets, observation notes, and semi-structured interview guidelines developed based on the research objectives and risk management framework. These instruments were used to support systematic identification and validation of risks associated with the implementation of the Outcome-Based Education assessment information system.

2.5 Risk Identification

Risk identification was conducted to systematically determine events or conditions that could potentially hinder the effectiveness and sustainability of the Outcome-Based Education (OBE)-based assessment information system. Qualitative data obtained from documents, observations, and interviews were analyzed through thematic identification of risk-related issues and subsequently structured into risk categories and a qualitative probability–impact matrix for prioritization, consistent with thematic analysis approaches commonly applied in qualitative organizational research [36], [37]. This stage aimed to capture risks emerging from institutional processes, assessment practices, data management mechanisms, and system implementation conditions within the faculty environment.

Identified risks were derived from qualitative data obtained through document analysis, direct observation, and semi-structured interviews. All relevant issues and potential risk events identified from these sources were compiled and structured into a risk register as the primary output of the risk identification stage. The risk register documented each risk in terms of description, potential causes, and the affected elements of the Outcome-Based Education (OBE)-based assessment information system.

To support subsequent analysis, risks were then grouped using a structured categorization approach based on similarity of risk sources and affected domains within the assessment system environment. The categorization results were presented in tabular form in the Results section to provide a systematic overview of the distribution of identified risks across major institutional dimensions.

2.6 Qualitative Risk Analysis and Prioritization

Following the risk identification stage, a qualitative risk analysis was conducted to evaluate and prioritize the identified risks based on the probability–impact matrix defined in the risk management framework. Qualitative risk analysis is appropriate when detailed quantitative data are unavailable and when the objective is to assess risks in complex organizational and information system contexts such as the implementation of an Outcome-Based Education (OBE)-based assessment information system [25].

Each identified risk was assessed using two criteria: probability and impact. Probability refers to the likelihood of a risk event occurring, while impact reflects the extent to which the risk may affect the effectiveness, reliability, and sustainability of the Outcome-Based Education (OBE)-based assessment information system in supporting learning outcome evaluation. The assessment was informed by expert judgment synthesized from multiple qualitative data sources, including document analysis, direct observation, and semi-structured interviews.

The probability and impact ratings were then combined using a probability–impact matrix as a qualitative analysis technique to determine the overall risk level. Based on this matrix, risks were classified into four priority levels: low, medium, high, and extreme. This prioritization served as the basis for systematic risk prioritization and subsequent risk response planning for the Outcome-Based Education (OBE)-based assessment information system. The use of qualitative risk prioritization through a probability–impact approach is consistent with established project risk management practices and has been widely applied in organizational and information system–related studies [25], [27].

2.7 Risk Response Planning

Risk response planning was conducted as the subsequent stage of the project risk management process following qualitative risk analysis and prioritization. This stage aimed to formulate planning-level response strategies to address identified risks by considering their potential likelihood and impact on the effectiveness and sustainability of the Outcome-Based Education (OBE)-based assessment information system.

Risk response options were determined in accordance with project risk management practices and included risk avoidance, risk mitigation, risk transfer, and risk acceptance [25]. The selection of response strategies considered the nature of each identified risk, institutional constraints, and the feasibility of implementation within the higher education context in relation to the operation and governance of the Outcome-Based Education (OBE)-based assessment information system.

In this study, the risk response planning process emphasized the identification of organizational and procedural response options rather than prescribing technical system redesign solutions. At the methodological level, this involved outlining response directions related to governance and coordination mechanisms, data management and integration practices, human resource capacity development, and the refinement of operational

procedures to support consistent utilization of the Outcome-Based Education (OBE)-based assessment information system. These responses were defined as planning-level strategies intended to guide subsequent decision-making and continuous improvement efforts, rather than as finalized implementation actions.

2.8 Research Procedure

The research procedure consisted of several sequential stages. First, preliminary observations and document reviews were conducted to understand the institutional context and implementation of the Outcome-Based Education assessment information system. Second, qualitative data were collected through document analysis, direct observation, and semi-structured interviews. Third, identified risks were compiled into a risk register and categorized based on their sources and affected domains. Fourth, qualitative risk analysis and prioritization were performed using a probability–impact matrix. Finally, planning-level risk response strategies were formulated based on the identified priority risks and institutional context.

3. RESULTS AND DISCUSSION

This section presents the empirical findings derived from the qualitative risk analysis of the Outcome-Based Education (OBE)-based assessment information system implemented at the Faculty of Engineering, Universitas Tidar. The results are structured according to the stages of project risk management, including identified risks, risk categorization, qualitative prioritization, and planned response strategies, followed by an integrated discussion linking the findings with relevant theoretical and institutional perspectives.

3.1 Identified Risks in Outcome-Based Education Assessment Implementation

Based on the risk identification stage conducted in this study, a total of 18 distinct risks were identified in relation to the implementation and utilization of the Outcome-Based Education (OBE)-based assessment information system at the Faculty of Engineering, Universitas Tidar. These risks were recorded as individual risk events in the risk register and constitute the primary empirical findings of the risk identification phase.

The identified risks originate from observed institutional practices and conditions related to system-supported assessment processes, data management mechanisms, human resource capacity, curriculum dynamics, operational procedures, and infrastructure conditions surrounding the Outcome-Based Education (OBE)-based assessment information system. Empirical evidence from documents, observations, and interviews indicates that the system operates within a complex institutional environment involving multiple interrelated components and stakeholders, thereby increasing exposure to uncertainty and potential disruption.

The results further show that the identified risks are not confined to technical aspects of the system. Instead, they also encompass organizational, operational, governance, and policy-related dimensions that directly influence the reliability and sustainability of the Outcome-Based Education (OBE)-based assessment information system. All identified risks provide the empirical basis for subsequent risk categorization, qualitative risk analysis, and risk response planning.

3.2 Risk Categorization

Based on the risk identification process, the identified risks were grouped into categories to provide a structured overview of the sources of risk in the implementation of the Outcome-Based Education (OBE)-based assessment information system at the Faculty of Engineering, Universitas Tidar. Risk categorization enabled the identification of dominant risk areas and supported subsequent analysis by organizing risks according to their primary origins within the system and its institutional environment.

The identified risks were classified into six categories: technical risks, data-related risks, operational risks, human resource risks, curriculum-related risks, and infrastructure risks. This categorization reflects the multidimensional nature of the Outcome-Based Education (OBE)-based assessment information system, which involves not only technological components but also organizational processes, academic structures, governance mechanisms, and supporting infrastructure.

Table 1 presents the distribution of identified risks across categories and priority levels. The table provides an aggregated overview of risk concentration and highlights areas with higher exposure to risk within the Outcome-Based Education (OBE)-based assessment information system implementation context.

Table 1. Distribution of Identified Risks by Category and Priority Level

Risk Category	Total Risks	Extreme	High	Medium	Low
Technical	4	1	3	0	0
Data-related	4	0	2	2	0
Operational	3	0	0	3	0
Human Resource	3	1	1	1	0
Curriculum-related	2	0	2	0	0

Infrastructure	2	1	0	1	0
Total	18	3	8	7	0

As shown in Table 1, technical risks represent one of the dominant categories at the high-priority level (3 risks) and also contribute to the extreme-priority level (1 risk), indicating that system architecture flexibility, integration readiness, and visualization performance are critical factors in the early development stage of the Outcome-Based Education (OBE)-based assessment information system. In contrast, data-related risks are concentrated mainly at the high (2 risks) and medium levels (2 risks), with no risks categorized as extreme. This indicates that although Program Learning Outcomes–Course Learning Outcomes standardization and mapping inconsistencies are significant, they remain manageable and have not yet reached a level that threatens overall system continuity.

Human resource risks and infrastructure risks each contribute one extreme-priority risk, highlighting vulnerabilities related to dependency on a limited number of developers and the readiness of the deployment environment supporting the Outcome-Based Education (OBE)-based assessment information system. Curriculum-related risks are entirely categorized as high-priority (2 risks), reflecting the impact of curriculum variability and accreditation requirements on system adaptability and configurability. Meanwhile, operational risks are distributed only at the medium-priority level (3 risks), indicating that procedural and user-related challenges affect day-to-day usage but remain within tolerable limits.

Overall, the risk categorization results demonstrate that risks associated with the Outcome-Based Education (OBE)-based assessment information system are distributed across multiple technical and organizational dimensions rather than concentrated within a single domain. This distribution underscores the complexity of the system as a socio-technical institutional mechanism and provides a structured basis for subsequent qualitative risk analysis and prioritization.

3.3 Qualitative Risk Analysis

Following the risk identification stage, the identified risks were further analyzed using qualitative risk analysis in accordance with the Project Risk Management process of the Project Management Body of Knowledge® Guide Sixth Edition. This stage aims to assess and prioritize risks based on their probability of occurrence and potential impact on project objectives, particularly the effectiveness and sustainability of the Outcome-Based Education (OBE)-based assessment information system in higher education.

Based on the prioritization results presented in Table 1, risks categorized at the extreme, high, and medium levels were summarized separately to provide a clearer classification of risk priorities. Table 2 presents the identified extreme risks along with their respective categories and descriptions, Table 3 summarizes the high-priority risks identified across different risk categories, and Table 4 presents the medium-priority risks that may influence operational reliability and user-level implementation of the Outcome-Based Education (OBE)-based assessment information system.

Table 2. Extreme Risks in Outcome-Based Education Assessment Information System Implementation

Risk ID	Risk Category	Risk Description
R2	Technical	Integration between system modules is not yet available
R12	Human Resource	Dependence on limited system developers (single point of failure)
R17	Infrastructure	System is still operating in a localhost environment

Table 3. High Risks in Outcome-Based Education Assessment Information System Implementation

Risk ID	Risk Category	Risk Description
R1	Technical	Database structure is not flexible enough to accommodate curriculum changes and Outcome-Based Education requirements
R3	Technical	System technical documentation is not yet available.
R4	Technical	Dashboard visualization has the potential to produce errors when processing large-scale data.
R5	Data-related	The weighting scheme between Program Learning Outcomes and Course Learning Outcomes has not been standardized.
R6	Data-related	The mapping of Course Learning Outcomes to Program Learning Outcomes is not consistent across courses/programs.
R13	Human Resource	High teaching workload among lecturers
R15	Curriculum-related	Differences in accreditation requirements between LAM Teknik and LAM INFOKOM.

R16	Curriculum-related	Curriculum changes affecting course and Course Learning Outcomes structures
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Table 4. Medium Risks in Outcome-Based Education Assessment Information System Implementation

Risk ID	Risk Category	Risk Description
R7	Data-related	Assessment data are incomplete.
R8	Data-related	Variations in Course Learning Outcomes structure across departments.
R9	Operational	The standard operating procedure (SOP) for data input is not yet available.
R10	Operational	Users do not yet fully understand the interpretation of Program Learning Outcomes achievement.
R11	Operational	Delays in the submission of assessment data.
R14	Human Resource	Differences in system operator competencies.
R18	Infrastructure	The system activity logging mechanism is not yet available.

As presented in Table 2, extreme risks are identified in the technical, human resource, and infrastructure categories, reflecting critical vulnerabilities related to the absence of system integration, dependency on limited developers (single point of failure), and the system's operation in a localhost environment. No extreme risks are observed in the data-related or curriculum-related categories, indicating that although these aspects present significant challenges, they have not reached an extreme severity level within this study.

Table 3 shows that high-priority risks are distributed across technical, data-related, human resource, and curriculum-related categories. This distribution indicates that high-priority risks are strongly associated with system design flexibility, lack of technical documentation, dashboard performance limitations, data weighting inconsistencies, lecturer workload, accreditation differences, and curriculum changes that directly affect the adaptability and reliability of the Outcome-Based Education (OBE)-based assessment information system.

Medium-priority risks presented in Table 4 are primarily associated with operational, data-related, human resource, and infrastructure aspects, including incomplete assessment data, variability in Course Learning Outcomes structures across departments, absence of SOP for system data input, limited user understanding in interpreting Program Learning Outcomes achievement, delays in data submission, differences in operator competencies, and the lack of system activity logging. Although these risks are not critical to system continuity, they may influence the effectiveness and reliability of Outcome-Based Education (OBE)-based assessment information system if not properly monitored.

Overall, the qualitative risk analysis results demonstrate that risks associated with Outcome-Based Education (OBE)-based assessment information system are present across interconnected technical, organizational, and academic domains, rather than being confined to isolated technical system issues. In line with the Project Management Body of Knowledge® Guide Sixth Edition, the identification and classification of risks across extreme, high, and medium levels provide a structured empirical basis for subsequent risk response planning by directing attention toward risks with the highest assessed severity.

3.4 Risk Response Planning

Based on the results of qualitative risk analysis and prioritization, risk response planning was conducted in accordance with the Plan Risk Responses process defined in the Project Management Body of Knowledge® Guide Sixth Edition. This stage focused on aligning identified risks with appropriate response strategies at the planning level rather than executing corrective actions within the scope of this study.

Risk response strategies were formulated by mapping risk priority levels to Project Management Body of Knowledge-defined categories: avoidance, mitigation, transfer, and acceptance. Consistent with the institutional and developmental characteristics of the Outcome-Based Education (OBE)-based assessment information system, mitigation and acceptance emerged as the dominant approaches, while avoidance was selectively applied to risks that posed structural threats to system continuity. Risk transfer was not considered applicable because the identified risks originated primarily from internal institutional and system-governance factors.

For risks classified as extreme priority, both avoidance and mitigation strategies were applied. Avoidance was assigned to R2 (absence of system integration) and R17 (operation in a localhost environment) by prioritizing architectural planning and controlled infrastructure migration before large-scale deployment. Mitigation was applied to R12 (dependency on limited developers) through planned team expansion and structured knowledge transfer to eliminate single-point-of-failure exposure within the Outcome-Based Education (OBE)-based assessment information system.

High-priority risks were addressed entirely through mitigation strategies across technical, data-related, human resource, and curriculum-related categories. These mitigation plans include restructuring the database

architecture (R1), developing technical documentation (R3), optimizing dashboard performance (R4), establishing faculty-level standards for Program Learning Outcomes–Course Learning Outcomes weighting and mapping (R5–R6), adjusting lecturer workload allocation (R13), and designing configurable system structures to accommodate accreditation and curriculum variability (R15–R16). These responses emphasize strengthening both system robustness and institutional governance mechanisms.

Medium-priority risks were managed through a combination of mitigation and selective acceptance. Acceptance was applied to R7 (incomplete assessment data) and R11 (delayed data submission) due to their manageable impact and dependency on gradual institutional compliance. Mitigation strategies were implemented for R8 (Course Learning Outcomes structural variability), R9 (absence of SOP), R10 (limited user interpretation capacity), R14 (operator competency gaps), and R18 (lack of system logging), focusing on procedural refinement, training, and system feature enhancement to improve operational reliability.

Overall, the risk response planning results demonstrate a structured alignment between risk priority levels and Project Management Body of Knowledge-recommended strategies within the context of the Outcome-Based Education (OBE)-based assessment information system. Extreme risks were addressed through avoidance and mitigation, high risks through mitigation, and medium risks through mitigation with limited acceptance, providing a coherent and sustainable framework for institutional risk control and continuous improvement.

3.5 Discussion

The findings of this study confirm that the implementation of Outcome-Based Education (OBE)-based assessment information systems in higher education is exposed to complex and multidimensional risks that may directly influence the validity, consistency, and reliability of learning outcome evaluation processes. The identified risks extend beyond technical concerns and affect how assessment evidence is generated, interpreted, and utilized for academic quality assurance and curriculum improvement. From a learning evaluation perspective, the quality of assessment systems is closely associated with the interpretability, consistency, and trustworthiness of assessment evidence used for educational decision-making. The identification of 18 distinct risks across technical, data-related, operational, human resource, curriculum-related, and infrastructure categories indicates that Outcome-Based Education assessment systems can be understood as functioning as socio-technical mechanisms with strong governance implications rather than standalone information technology artifacts. This interpretation is consistent with broader risk management perspectives in education, which emphasize that institutional risks often emerge from interactions between organizational processes, regulatory demands, and information systems rather than isolated technical failures [38], [39].

A key insight derived from the qualitative risk analysis is the concentration of data-related risks primarily at the high-priority level, particularly those related to non-standardized Program Learning Outcomes–Course Learning Outcomes weighting and inconsistent Course Learning Outcomes–Program Learning Outcomes mapping across courses within the Outcome-Based Education (OBE)-based assessment information system. These conditions directly threaten the validity and reliability of learning outcome measurement, which constitutes the core objective of Outcome-Based Education assessment. Recent educational assessment literature further emphasizes that assessment validity is fundamental to ensuring accurate interpretations of student capability and learning achievement in higher education environments [40]. In educational measurement contexts, inconsistencies in weighting structures and Program Learning Outcomes–Course Learning Outcomes mapping may also introduce measurement error by producing distorted representations of student competency achievement across courses and study programs. As a consequence, assessment results generated by the Outcome-Based Education (OBE)-based assessment information system may not accurately represent actual student competency achievement. This condition can weaken the credibility of program evaluation, reduce the effectiveness of curriculum improvement processes, and complicate evidence-based accreditation assessment. This finding aligns with previous studies highlighting assessment alignment and data governance as critical success factors in outcome-based education systems [8], [23]. Similar challenges have also been observed in information system–supported assessment environments, where fragmented data structures and ambiguous academic rules reduce decision quality and weaken institutional accountability [41].

In addition, maintaining consistency in the interpretation of Program Learning Outcomes achievement across study programs requires faculty-level control over assessment structures and aggregation mechanisms within the Outcome-Based Education (OBE)-based assessment information system. Variations in the number of Course Learning Outcomes mapped to each Program Learning Outcomes and the absence of standardized weighting schemes at the program level may lead to inconsistencies in aggregated Program Learning Outcomes results. To minimize this potential distortion, the Outcome-Based Education (OBE)-based dashboard system was intentionally designed to remain dynamically configurable while imposing structural limits, such as restricting the maximum number of Course Learning Outcomes per course, thereby preserving comparability and calculation accuracy across study programs. Without such controls, differences in Course Learning Outcomes structures and weighting mechanisms may produce inconsistent interpretations of student learning achievement across programs, thereby reducing the comparability of educational evaluation results.

Risks related to differences in accreditation requirements between LAM Teknik and LAM INFOKOM were classified at the high-priority level. This finding further illustrates the influence of external regulatory complexity on institutional risk exposure affecting the assessment information system. Higher education institutions operate within layered governance environments, where accreditation standards, quality assurance policies, and professional body requirements interact and impose constraints on assessment system design and implementation [21], [24]. From a governance perspective, such regulation-induced risks can be interpreted as strategic in nature, as they require anticipatory planning and adaptive institutional policies rather than isolated technical interventions [28], [42]. These conditions demonstrate that assessment information systems in Outcome-Based Education environments must support not only administrative reporting requirements but also consistent and credible evaluation of learning outcomes across varying accreditation frameworks.

This regulatory variability also reinforces the necessity of developing an assessment system that is structurally independent from existing academic information systems. Considering that Outcome-Based Education adoption at Universitas Tidar is still incomplete and not fully accommodated within the current Academic Information System framework, early integration was deliberately avoided to prevent structural incompatibility. Instead, the study supports a phased institutional strategy in which the Outcome-Based Education (OBE)-based assessment information system is positioned as a standalone core platform, with long-term plans for direct migration from the Academic Information System once curricular alignment across study programs has matured.

Beyond strategic and regulatory dimensions, the presence of high and medium risks in operational and human resource categories underscores the significance of organizational capacity and human factors influencing the Outcome-Based Education (OBE)-based assessment information system. Risks related to the absence of standardized operating procedures, limited understanding of Program Learning Outcomes interpretation, high academic workloads, and reliance on a small number of system developers reflect organizational vulnerabilities commonly encountered in complex institutional projects. Comparable patterns have been reported in enterprise and public-sector risk management literature, which emphasizes that coordination mechanisms, human resource readiness, and institutional culture play decisive roles in shaping risk management effectiveness [22], [30], [39]. From an educational evaluation perspective, limitations in user understanding, assessment literacy, and operational consistency may also affect the interpretation and utilization of assessment evidence, thereby influencing the quality of academic decision-making based on Outcome-Based Education assessment results [43]. This finding is consistent with data-based decision-making literature emphasizing that the effective use of educational data depends not only on data availability, but also on institutional capacity for sense-making, interpretation, and evidence-informed improvement processes [12].

To address sustainability risks arising from limited developer involvement, the study emphasizes internal knowledge preservation through systematic technical documentation and the continued engagement of previous developers within the governance structure of the evolving system. This approach is intended to prevent discontinuity in system development and ensure that institutional knowledge remains internally retained without dependency on external parties.

These empirical patterns are further supported by project risk management research demonstrating that the effectiveness of risk management practices is influenced more by governance structures and stakeholder coordination than by technical tools alone. Carvalho and Rabechini Jr. (2015) show that the relationship between risk management and project performance is largely mediated by organizational capabilities and soft skills, a conclusion that is consistent with the predominance of non-technical risks observed in this study [44]. This perspective helps explain why improvements limited to technical system features are insufficient to address the broader risk landscape associated with the Outcome-Based Education (OBE)-based assessment information system. Within Outcome-Based Education assessment environments, these organizational capabilities are essential to ensure that assessment processes remain interpretable, consistent, and institutionally accountable.

From an educational practice perspective, the findings highlight several important implications for improving the quality of learning outcome evaluation in higher education. First, strengthening faculty-level standardization of Program Learning Outcomes–Course Learning Outcomes mapping structures and assessment weighting mechanisms is essential to improve consistency, comparability, and validity of assessment results across study programs [19]. Second, continuous lecturer and operator training is necessary to enhance assessment literacy, understanding of Program Learning Outcomes interpretation, and the utilization of assessment evidence for academic decision-making [10], [45]. Third, the findings reinforce the importance of integrating risk-informed governance into institutional quality assurance processes to support accreditation readiness, curriculum improvement, and sustainable implementation of Outcome-Based Education assessment practices [46], [22], [47]. Collectively, these measures may improve the credibility and reliability of learning outcome evaluation within higher education environments.

From a methodological standpoint, the use of qualitative risk analysis based on a probability–impact matrix proved appropriate for prioritizing risks within a context characterized by limited quantitative data and high institutional complexity. Qualitative approaches are widely regarded as suitable for organizational and

information system projects where uncertainty arises primarily from policy dynamics, human behavior, and governance arrangements rather than from statistically measurable failure rates [25], [35]. In addition, failure-oriented qualitative techniques, as discussed by Carbone and Tippett (2004), support the identification of critical risk areas by emphasizing severity and potential impact rather than numerical precision [48].

The application of a Risk Breakdown Structure (RBS) in this study contributed to structuring the analysis by organizing identified risks into coherent categories based on their primary sources within the Outcome-Based Education (OBE)-based assessment information system. By providing a systematic way to group risks, the RBS facilitated analytical clarity and supported subsequent risk analysis and response planning within the institutional context examined [49], [50].

The findings also suggest that risks within Outcome-Based Education (OBE)-based assessment environments should be interpreted not merely as threats to system operation, but as factors that may influence the quality of learning outcome evaluation and the accuracy of assessment-based academic decision-making. Taken together, the findings indicate that risks in Outcome-Based Education (OBE)-based assessment information systems should not be interpreted solely as technical or operational vulnerabilities. More importantly, these risks influence the credibility of learning outcome evaluation processes, including the consistency of Program Learning Outcomes achievement interpretation, the validity of assessment evidence, and the reliability of quality assurance practices in higher education. Consequently, risk management within Outcome-Based Education (OBE) assessment environments should be positioned as an integral component of educational evaluation governance rather than merely a system maintenance activity.

Overall, this study contributes to the literature on risk management in higher education by offering an empirical, assessment-focused analysis grounded in established project risk management principles. While previous research has largely concentrated on instructional risks or general institutional governance, this study positions the Outcome-Based Education (OBE)-based assessment information system as a critical yet underexplored locus of risk. By framing Outcome-Based Education assessment as a socio-technical system with significant governance considerations, the findings underscore the importance of integrating structured risk management practices into institutional quality assurance frameworks. Sustainable Outcome-Based Education implementation therefore depends not only on robust information systems, but also on coherent assessment standards, organizational readiness, and adaptive governance mechanisms that support credible learning outcome evaluation.

4. CONCLUSION

This study aimed to identify, categorize, and prioritize risks associated with the implementation of an Outcome-Based Education assessment information system in higher education using a qualitative project risk management approach. Through the application of qualitative risk analysis based on the Project Management Body of Knowledge® Guide Sixth Edition, the study identified 18 risks distributed across technical, data-related, operational, human resource, curriculum-related, and infrastructure categories.

The findings demonstrate that risks within Outcome-Based Education assessment information systems extend beyond technical concerns and may affect the validity, consistency, and reliability of learning outcome evaluation processes. High-priority risks were primarily associated with inconsistencies in Program Learning Outcomes–Course Learning Outcomes mapping, assessment weighting structures, curriculum variability, and organizational readiness, highlighting the importance of assessment governance and institutional coordination in supporting credible learning outcome evaluation.

This study contributes to the literature by positioning the Outcome-Based Education assessment information system as a socio-technical educational evaluation mechanism rather than merely a technical information system. Practically, the findings emphasize the importance of faculty-level standardization, assessment literacy development, and risk-informed quality assurance practices to support accreditation readiness and sustainable implementation of Outcome-Based Education in higher education.

Future research may incorporate quantitative risk assessment methods, evaluate the effectiveness of implemented mitigation strategies, or conduct comparative studies across institutions to further examine factors influencing the quality and sustainability of learning outcome evaluation systems.

ACKNOWLEDGEMENTS

The researchers would like to thank all parties involved in this research.

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