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INTEGRATED RISK MANAGEMENT IMPLEMENTATION BASED ON ISO 31000:2018 AND PMBOK FRAMEWORK IN PALM OIL MILL CONSTRUCTION PROJECT

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ABSTRACT. The construction of palm oil mills is a complex process influenced by various technical, social, and environmental factors, leading to significant risks, including construction delays, budget overruns, and compromised quality. The sector often neglects to implement effective risk mitigation strategies, resulting in challenges during the planning stage, particularly surrounding structural planning risk and social risk considerations during project approval. This research focuses on the risk management integration within palm oil mill construction at PT HPI, specifically utilizing ISO 31000:2018 and PMBOK during initial planning and design phases. Using a mixed-method approach, data was collected through in-depth interviews and semi-structured questionnaires aimed at experienced professionals in the industry, an analysis of the collected data, through a probability/impact matrix, identified 14 key risk duting the planning stage of palm oil mill project. The three most critical risks highlighted were: 1) Misalignment between project design and intended outcomes, 2) Slow progression in planning caused by unclear data and poorly defined project scope, and 3) delays in necessary bureaucratic approvals. The research indicates that the integration of ISO 31000:2018 with PMBOK facilitates the development of a comprehensive risk management plan. This approach aims to reduce the likelihood of schedule delays, control costs more effectively, and improve the organization's capability to address social and environmental risks in future palm oil mill projects.

INTRODUCTION

The palm oil business is key to the Indonesian economy, contributing significantly to foreign exchange earnings, employment creation, and regional development outside of Java Island (Azahari, 2024). Indonesia is as advantages as the world's first producer and exporter of crude palm oil (CPO). Therefore, the sustainability and the competitiveness of this industry are of great concern to governments and businesses. Palm Oil Mills (POM) are the leading processors of fresh fruit bunches (FFB) and convert them into CPO and other derivatives, and requiring specialized technology and large investments (Waruwu and Simanjuntak, 2020), various early- stage supply chain risks, such as capacity imbalances, construction delays, and operational standstills, can negatively affect the entire palm oil supply chain (Putri *et al*., 2020; Rohimmah *et al*., 2022).

Small and Medium Enterprises assess their problems differently due to their social, environmental, and legal complexities, and their interaction with each other, as opposed to focusing strictly on financial matters (Iqbal, 2025; Melly and Purwaningrum, 2018). Given the limited technology and/or capacity, SMEs face operational challenges such as variant design outputs, unresolvable geotechnical conditions, layout design issues, and Existing facilities bound by problematic entailments (Soemardi *et al*., 2021). Moreover, within financial constraints, there are risks losses due to budget cuts, budget reallocation, and budget overruns. Social and/or environmental challenges such as hostility from local community, land use conflicts, project sustainability, project stalemates, legal compliance, and project blockage further

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complicate the already difficult challenges to be managed (Putri *et al*., 2020; Rohimmah *et al*., 2022). In the sugar and agro-industry, rather than the financial and operational outcomes, the positive impact of reduced conflict on work efficiency due to the absence of management problems is known (Melly and Purwaningrum, 2018). The palm oil industry is a sector with a high degree of risk. There are many players in this industry, and there needs to be a collaborative approach in the management and mitigation of risks from the processing stage to avoid a wasteful iteration in the subsequent stages (Putri *et al*., 2020; International Organization for Standardization, 2018; Project Management Institute, 2017; Paillin *et al*., 2024).

Although ISO 31000:2018 explains the importance and fundamentals of value-based governance of risk, the PMBOK guidelines provide go into more detail on risk planning, risk identification, risk analysis, risk response, and risk monitoring. The two frameworks put together provide an adaptable and complete approach for mhanagdling the risks of every stage of a construction project, particularly in the case of the construction of palm oil mills in agro-industrial contexts (International Organization for Standardization, 2018; Project Management Institute, 2017) The integration of ISO 31000:2018 and PMBOK for risk management planning in agro-industrial projects is reinforced by previous research oin infrastructure projects (Pratiwi *et al*., 2024; Vargas and Campos, 2022).

Specific Palm Oil Mill (POM) construction projects practice risk management. However, at times, it is as rudimentary as a basic risk register or, a regulatory document without real integration into the project management and control cycle. Some key risks include the discrepanciesy between designs and the predicted mill capacity, delays in obtaining permits, and, during the planning phase, an ambiguous scope of work during the planning phase. This results in timeline setbacks, unnecessary redesign, and construction cost surges (Titarenko, 2025). Risk management studies of the agricultural sector cite a lack of planning as a cause of reduced efficiency and productivity, while also increasing costs throughout logistics and operations (Azahari, 2024; Putri *et al*., 2020; Rohimmah *et al*., 2022). Risks such as land clearing and waste management issues may harm the environment, and best practices for utilizing palm oil waste are is supported by recent community outreach studies (Syarif *et al*., 2024). A lack of risk management planning for construction projects can result in a negative outcomes equivalent to those at of POM the palm oil mill projects.

Management research and practical studies generally target the supply chain of CPO and its derivatives, as well as plantation-level agronomic risks and socio-environmental factors within the palm oil industry (Azahari, 2024; Rohimmah *et al*., 2022). However, few studies have concentrated on the advanced level of integrated risk management perspective during the construction of palm oil mills (POMs), specifically applying ISO 31000:2018 and PMBOK. This construction phase is crucial because it determines the readiness of production facilities, cost structures, and operational smoothness in the coming years. This research gap provides an opportunity to develop an effective, sophisticated, and superior risk management implementation model for POM projects in Indonesia (Rohimmah *et al*., 2022).

This study produces a structured risk management plan that can serve as a reference for future palm oil mill construction projects, particularly to reduce planning delays, cost increases, and social and environmental conflicts. Academically, this study helps develops an integrated risk management approach that combines ISO 31000:2018 and PMBOK in the context of agro-industrial construction projects, an area that remains underdeveloped in the existing literature.

PT HPI, the company studied in this research, is building a new POM with particular size and location features. The company encountered several challenges during the project, including misaligned initial design and operational requirements, concerns about permitting, and delays in completing planning documents, which impacted the construction timetable. Such circumstances suggest that the existing risk management practices do not sufficiently intermesh with the project management cycle. Hence, a risk management plan is needed by combining aspects of ISO 31000:2018 and the project risk management process as described in the PMBOK. This would lead to the development of an operational risk management plan, that which is more appropriate for the POM to be built. As a result, this study is intended to provide answers to specific fundamental questions.

First, what were the technical, administrative, and socio-environmental hazards that surfaced during the planning of the POM construction project at PT HPI? Second, how can one assess the likelihood and consequences of each risk using at the risk matrix, one of the semi-quantitative approaches? Third, how can we develop a cohesive risk management plan through the integration of ISO 31000:2018 and PMBOK that can guide the management of risk in micro and small enterprise development projects? A response to this question is necessary to reconcile the general risk management principles with the peculiarities of agro-industrial projects.

This study the focuses on examining this research is examine the application of integrated risk management systems based on ISO 31000:2018 and PMBOK in palm oil (POM) construction projects at PT HPI. In particular, this study research seeks to: (1) identify and describe the main project plan stage risk; (2) evaluate risks using a partial semi-quantitative risk analysis matrix to determine the appropriate management level; and (3) develop ISO 31000:2018 and PMBOK-compliant risk management plans. For the company, a systematic risk management plan will provide benefits as a benchmark for risk management in the current POM project and its future equivalents, thus alleviating delays, cost escalation, and socio-environmental conflicts. This research expands the integration of construction projects in the agricultural and agro-industrial industries, especially the palm oil subsector. The research output will be helpful to policymakers and industry stakeholders by providing a basis for establishing technical documents or internal risk management protocols for agro-industrial projects, particularly in the palm oil subsector.

Previous studies on palm oil and agro-industry projects have largely focused on issues such as supply chain risk, operational performance, and sustainability. However, during the planning and design stages of palm oil mill construction, the focus on integrated risk management remains limited, primarily because project-level operational risk processes are combined with organizational-level risk governance. Therefore, this study addresses this issue.

RESEARCH AND METHODS

Research Framework

The study employed a mixed-methods research approach, incorporating both qualitative and quantitative methods (Figure 1). Qualitative approaches concerned mostly the types of risk and systems of risk management as well as the professional views (which was), although the type of problem being addressed, which is risk management in a construction project of a palm oil mill, requires both in-depth contextual and practical experience of the project actors, and a structured way of measuring risk and impact, (which is the quantitative approach). Even Although qualitative approaches were employed to provide a numerical estimate of the possibility and impact of each risk, the outcome was still quantitative. This was achieved through a risk matrix and a semi-quantitative questionnaire, which enabled a more logical prioritization of risk management.

For this setup, data, both quantitative and qualitative, were not considered in isolation, as was the norm. The results from the interviews were combined to form a composite risk and indicator list, which was subsequently tested with a questionnaire. For the sake of the prevailing relevance to the present project situation, the quantitative and qualitative results were compared. This approach is more efficient and recommended for the studies in risk management and agro-industrial development, this approach is more efficient and recommended as it is more integrated and cohesive than when conducted separately (Paillin *et al*., 2024).

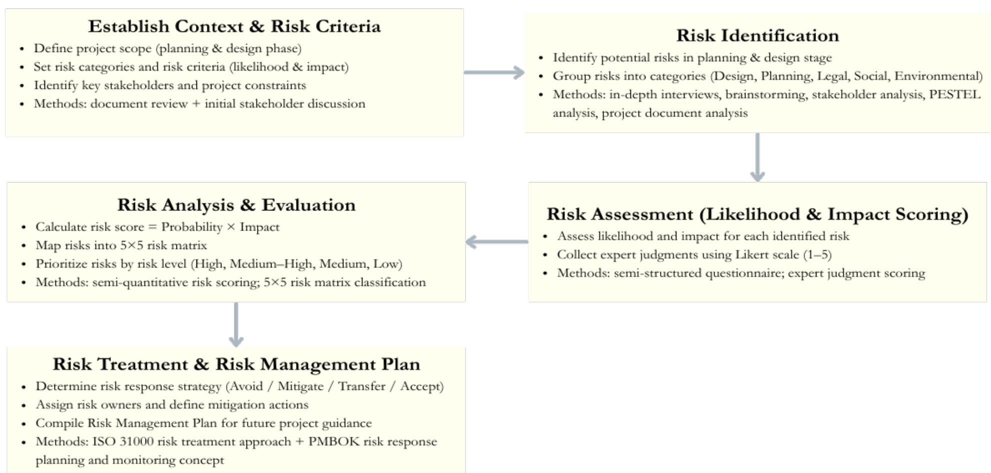

Figure 1. Research framework for integrated risk management based on ISO 31000:2018 and PMBOK

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The study was conducted carried out between January and March 2025, coinciding with the project's early planning and design stages. This timing is critical because many of the risks examined, such as mismatches in design output, delays in obtaining permits, and uncertainties in project scope, typically appear or become more visible during this phase. Collecting data while these activities were taking place allowed the researcher to follow the decision-making processes and the ways in which risks were handled as they unfolded, rather than depending only on past documentation or retrospective accounts.

Population and Sample

This investigation involved all stakeholders of PT HPI, including those involved in the planning and management of the palm oil mill construction. This group comprises project managers, planning engineers, technical personnel, finance and procurement representatives, permit issuers, and liaison officers for external stakeholders.

According to Niegel, purposive sampling is a sampling technique in which the participants in the study are handpicked to fulfil specific objectives of the study objectives. In this study, the main criteria were as follows: (1) having been involved in or managing a construction project in a palm oil mill or equivalent for a period of no less than eight years, and (2) possessing a good command of the company's intricacies of planning, decision-making, and risk management. Based on these aspects, two categories of respondents were formed:

1. The first group included ten senior respondents, all of whom were project managers, heads of technical units, and risk and compliance officers, and who served as key informants in the in-depth interviews.
2. The second group included approximately total of about 30 respondents who were in mid-management and technical support roles in the project and completed a semi-quantitative questionnaire.
3. This approach guaranteed that the data available data was indicated of a considerable comprehension of the actual context and the various views of the organization.

Data Collection Techniques

The collection process in this case consisted of two main elements: interviewing stakeholders and distributing semi-structured quantitative questionnaires. To obtain firsthand information on the type and pattern of risks borne by palm oil mill (POM) projects, stakeholders, as well as on risk mitigation, optimum practices, and management, and the detailed nature of the practices, interviews were conducted. Considerable information was obtained from the interviews to conceptualize the mapping of risks and prepare a draft of the planning, design, legislative, and social and environmental risk clusters. Furthermore, the design of the semi-structured quantitative questionnaires relied on the interviews and the literature to provide a framework of the risks. Likert items were employed to assess the risk in particular. To harmonize the respondents' ratings and justify the level of consensus, a sample of 30 respondents with the appropriate profile and experience who answered the questionnaires were surveyed. For the primary data, to avoid possible secondary and corroborating data, the researcher examined the internal organizational project records, in particular the risk management, planning, status, and organizational chart documents. The first input goal of document analysis was to ascertain that the risk management plan was in alignment with the management and governance of that organization.

Data Analysis Techniques

The analysis of the data used both descriptive qualitative and semi-quantitative risk analyses. Thematic analysis was used on the interview data to group participant statements into main themes, such as risk sources and management challenges. This created a risk breakdown structure (RBS). It also clarified the quantitative results by explaining how the scores were assigned. In the semi-quantitative method, the answers to the questionnaire were assigned numbers for likelihood and impact, which led to risk ratings that were used to categorize them into levels (low to very high). Based on the risk rankings, management strategies were suggested that followed the ISO 31000:2018 and PMBOK guidelines. These strategies included avoidance and mitigation. Finally, PT HPI developed a complete risk management plan that listed the most important risks and the steps that need to be taken to reduce them for future palm oil mill construction projects.

RESULTS AND DISCUSSIONS

Risk Identification

For the PT HPI construction of the palm oil mill, risk identification processes were based on interviews and semi-quantitative questionnaires completed by project design and management experts. The interviews provided qualitative insights into the risks associated

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with previous projects. The questionnaires were also distributed to obtain in-depth information and broaden the category of respondents concerning the risks. This also demonstrates the spirit of risk recognition in the agro-industrial sector and emphasizes the importance of partnerships with primary actors to identify, alongside technical risks, the most critical non-technical risks.

This section identifies the key risks encountered during the planning and design phases of the palm oil mill construction project at PT HPI (Table 1). Risk identification was conducted through a combination of in-depth interviews, semi-structured questionnaires, and document analysis in accordance with the principles of ISO 31000:2018 and the risk management process outlined in the PMBOK guide. Identified risks were categorized into design, planning, legal, social, and environmental risks to facilitate systematic analysis and the formulation of appropriate mitigation strategies.

Table 1. List of key risks for the PT HPI POM development project

Risk Category	Risk Event / Incident	Risk Description	Impact	Solution (Risk Treatment / Response)
Design Risk	Delayed design process	Design activities are delayed due to unclear scope, incomplete data, and coordination issues between engineering parties	Delay in project planning completion	Mitigation: establish design schedule baseline, assign cross-functional PIC, and conduct regular design review meetings
	Unclear equipment and machinery specifications	Equipment and machinery specifications are not clearly defined, causing multiple interpretations	Specifications do not match operational needs	Mitigation: standardize equipment datasheets, conduct vendor clarification sessions, and implement design freeze for critical items
	Design does not meet output target	Final design does not align with targeted plant capacity and operational requirements	Major redesign and project delay	Transfer/Mitigation: conduct feasibility re-validation, cross-functional design review, and engage third-party design consultants
Planning Risk	Lack of site information	Insufficient and inaccurate field data during early planning	Delay in planning completion	Mitigation: conduct comprehensive site surveys, apply field data checklist, and centralize technical data documentation
	Inadequate feasibility study	Key feasibility aspects are not thoroughly assessed	Inaccurate project assessment	Mitigation: strengthen feasibility study scope, perform peer review, and validate assumptions using historical project data
	Delayed planning process	Difficulty obtaining detailed data, unclear scope, and slow approval of planning documents	Delay in project planning completion	Mitigation: clarify project scope through WBS and RACI, define planning milestones, and apply proactive planning control
	Planning results cannot be executed	Planning outputs are not feasible due to lack of suitable technology or skilled workforce	Increased project cost	Mitigation: prepare alternative plans, conduct readiness assessment, and provide technical training or external support

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Risk Category	Risk Event / Incident	Risk Description	Impact	Solution (Risk Treatment / Response)
	Unclear work scope and definition	Work scope is poorly defined, leading to misalignment among stakeholders	Delay in planning completion	Mitigation: develop detailed scope statement and WBS, conduct scope validation workshops, and baseline approved scope
Legal Risk	Excessive bureaucracy	Licensing and permit procedures are complex and time-consuming	Delay in project planning completion	Transfer/Mitigation: map permit requirements and timelines, establish early coordination with authorities, and engage local legal consultants
	Lengthy negotiations	Prolonged negotiations with local government and external stakeholders	Delay in decision making	Transfer/Mitigation: prepare negotiation strategy, set decision deadlines, and involve third-party facilitators
	Changes in regulations	Regulatory changes occur during project preparation	Project discontinuity or document revision	Mitigation: conduct regular regulatory monitoring, maintain compliance register, and prepare adaptive permit strategies
Social Risk	Community rejection	Local communities oppose or resist the project development	Delay in field surveys and activities	Transfer/Mitigation: conduct early socialization, map local stakeholders, and mediate through community and traditional leaders
Environmental Risk	Environmental damage	Construction activities potentially cause environmental degradation	Additional environmental assessment and mitigation cost	Mitigation: implement environmental management plan, control land clearing, and monitor environmental impacts
	Poor waste management	Inadequate waste handling and disposal practices	Hindrance to project development	Mitigation: prepare waste management plan, establish SOPs, appoint licensed waste vendors, and conduct compliance audits

The research results indicate that design- and planning-related risks predominate during the early project phase and have the greatest impact on schedule and cost performance. While social and environmental risks are typically moderate, proactive management is necessary to prevent disruptions, particularly legal risks, which stem primarily from external regulatory processes. The options offered meet the ISO 31000:2018 risk management standard and the PMBOK risk response strategy. Thus, the risk register can be used as a practical reference for future project mitigation.

Risk Analysis

The use of semi-quantitative tools, such as the opportunity impact matrix, allows the process of identifying risks to continue. Analysts assign a numerical value of five or ten to determine the risk for a given period, based on two variables: the likelihood of the risk occurring and the potential loss the project would incur if the risk were to materialize. Both variables of the risk are combined, and a risk score is calculated. This risk score is then used to prioritize the risks. Such a practice aligns with analytical risk

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frameworks and supply chain studies that examine the use of risk matrices in the agro-industries, offering complex yet straightforward assessments to rational agents involved.

The primary risks associated with the highest scores are (1) design output inconsistency, (2) delays in the planning process, and (3) procedural permitting delays. Design output inconsistency is the highest risk because it is the most probable and influential. Errors made in the design phase can lead to the complete construction of a plant, including but not limited to undersized designed capacities and long-term operational inefficiencies, as well as the need to redesign multiple times during the process. Deficiencies in the planning phase also have a significant impact on unregulated overhead costs, as planning phase deficiencies cause a cascade of construction scheduling delays, thereby extending the duration during which overhead costs are incurred unilaterally across the project. Above all, the most impactful is permitting procedural delays are the most impactful, as they can halt or significantly slow down construction.

Risk Evaluation

We analyze all the risks associated with the PT HPI project and determine if they are acceptable based on a set of criteria. The company's risk tolerance, resource availability, and relevant rules set the standards for accepting a project. Risks with a high probability of occurrence and a significant effect are called priority risks and must be addressed immediately. Risks that receive a moderate score can still be reduced by keeping an eye on them and following appropriate procedures. Risks with a low score are considered acceptable (risk acceptance) and can be handled with regular monitoring; therefore, no additional resources are required. Design, scheduling, and permitting problems caused by poor documentation and unclear bureaucratic delays are some of the most important and urgent issues for the PT HPI palm oil mill (POM) development project.

These three issues are important for developing additional methods to lower risk; the assessment recommends thorough validation of capacity and technical specifications through an extensive feasibility analysis and collaborative interdisciplinary efforts, considering design hazards. The evaluation suggests improvements to clarify the scope and schedule and to encourage coordination between agencies to reduce the risk of planning delays. To overcome bureaucratic problems with licensing, it is sufficient to map out the relevant rules and licensing schedules for each instrument and to make arrangements with the appropriate stakeholders.

Likelihood, impact, and risk scores presented on Table 2. The table explains the probability assessment criteria used in risk analysis, ranging from rare to almost certain, with a percentage range of occurrences ranging from less than 10% to more than 80%. Each probability level reflects how often a risk could potentially occur during the project, which is then combined with the impact level to determine the risk value. This grouping forms the basis for the risk assessment and prioritization process, helping the project team identify risks that need to be addressed in depth and intensively.

Risk classification by priority level, with the results of risk grouping based on the priority level of the risk value generated through probability and impact analysis presented on Table 3. High category risks, namely point 15, include design non-conformity, delays in the planning process, and permit bureaucracy that require immediate handling because they have a very significant impact on the project plan. Medium to high risks with point 12, such as unrealizable planning, prolonged negotiations, community rejection, and design delays, these various things still require in-depth attention.

Finally, medium to low risks with points 6 to 9 can be managed through routine monitoring. Comprehensively, this classification confirms that risks in the design, planning, and legal aspects are the main priority in project implementation from planning to realization to minimize delays and cost overruns. The findings of this study are consistent with previous agro-industrial risk management studies, which emphasize the importance of early-stage risk identification and mitigation to improve project performance (Rohimmah *et al*., 2022; Wibowo *et al*., 2023).

Integration of ISO 31000:2018 and PMBOK

To develop a risk management plan that aligns with ISO 31000:2018 and the project risk management processes outlined in the PMBOK guide, risk must first be identified, analyzed, and evaluated. The PMBOK guide specifies project-level activities, such as planning, risk identification, qualitative and quantitative analysis, response planning, and ongoing monitoring. In contrast, ISO 31000:2018 provides a broader framework that emphasizes value creation and organizational integration. Combining both references allows the development of a risk management plan that is consistent with international standards while remaining practical for project implementation.

Table 2. Likelihood, impact, and risk scores

Severity Rating	Information	Percentage
Rare	Risks that are unlikely to occur, i.e., risks with a rare occurrence rate of less than 10%	1-20%
Improbable	Very rare, Risks that have a low probability of occurring, but cannot be completely excluded	21% - 40%
Possible	Risks that have a periodic probability of occurring	41% - 60%
Highly Probable	Risks with a probability of occurring in the range of 60% - 80%	61% - 80%
Almost Certain	Definitive risks that have the highest frequency (generally more than 80%) of occurrence during a specific project phase	> 80%

Table 3. Risk classification by priority level

Risk Category		Risk Event	Risk Value	Level
R3	Design	Design does not meet project output expectations	15	High
R6	Planning	Delay in planning process	15	High
R9	Legal	Excessive licensing bureaucracy	15	High
R7	Planning	Design results cannot be implemented	12	Medium-High
R10	Legal	Lengthy negotiation with local government	12	Medium-High
R12	Social	Community rejection of project development	12	Medium-High
R1	Design	Design process delay	12	Medium-High
R4 R14	Other (Planning, Environmental)	Moderate risks	6–9	Medium-Low

Table 4. Risk levels and priority risk mitigation decisions

Risk Event	Risk Level	Risk Response Strategy	Key Mitigation Action
Design does not meet output target	High	Transfer / Mitigation	Conduct design validation and feasibility re-check; engage third-party design consultants
Delayed planning process	High	Mitigation	Clarify project scope through WBS and RACI; apply proactive planning control
Excessive licensing bureaucracy	High	Transfer	Engage local legal consultants and establish early coordination with authorities
Planning results cannot be executed	Medium–High	Mitigation	Prepare alternative planning scenarios and conduct technical readiness assessment
Lengthy negotiations with external parties	Medium–High	Transfer	Involve third-party facilitators and define negotiation deadlines
Community rejection	Medium–High	Mitigation	Conduct early socialization and stakeholder engagement through community leaders

In practice, integration involves aligning the ISO 31000 Process with the PMBOK risk management flow, organizing the work into stages such as establishing the context, identifying risks, analyzing and evaluating them, determining appropriate treatments, and implementing follow-up actions. This approach resulted in a comprehensive risk management plan for the PT HPE Project, covering the

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project context, organizational responsibilities, a list of key risks and risk owners, mitigation strategies, and relevant control mechanisms. The plan ensured that risk management was integrated with the project's schedule, budget considerations, and operational decision-making.

From both academic and practical perspectives, the application of ISO 31000:2018 and PMBOK in agribusiness projects demonstrates the value of a structured and systemic risk management approach. This integration is expected to support the smoother implementation of PT HPI's future projects, reduce unnecessary costs, and strengthen responsiveness to social and environmental risks, consistent with previous research findings on risk management within agri-food supply chains

Table 4 shows the evaluated risk levels and priority risk mitigation decisions. To ensure that high-impact risks are addressed through appropriate, actionable decisions, the selected response strategies and mitigation actions must align with ISO 31000:2018 risk management principles and PMBOK risk response planning. This decision table demonstrates the practical application of risk management in a future palm oil mill construction project.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

This research explores the palm oil mill construction project of PT HPI for possible implementable threat mitigation strategies ISO 31000:2018 and PMBOK Guide Deals with Planning and Design of Projects. Through the conducted interviews and surveys, certain 14 potential risks in the planning, procuring, human resources, and environment crises situations were defined, consistent with previous studies in the Indonesian agroindustry sector. The most critical challenges recognized in the planning and in the recruitment stages included lack of consistency and gaps in the interrelationship of the project scope and the objectives, a standstill in the flow of action during the planning phase, and difficulty in acquiring the needed permits.

The research attempted to resolve the gaps through an aggregate approach, including procedural risk management planning, mitigation, and control responses to the specific risks. The model of integrated risk management proposed the ability to make better and improved decisions by removing and lessening the risks, and the ability to minimize the anticipated time frames, all of which are consistent with the findings of contemporary literature on the project risk management in the agroindustry. The adoption and further refinement of these practices will continue to provide a positive impact on the oil palm sector in Indonesia.

Recommendations

It is required that PT HPI utilize and apply RM principles in the IRMP. More specifically, IRMP RM should be merged in the qualification and planning phase of the IRMP so that the relevant risks can be identified, analyzed, and scoped; can frame the schedule and cost of the project; and the relevant risks can be scoped, scheduled, and costed. Each risk has to be assigned to an owner, classified, ranked in tiers based on the importance, and assigned to measurement criteria that should be integrated into the dashboard for the project. The dashboard should be able to apply the required control actions based on the criteria value should the criteria be breached. Improvement of personnel qualified on ISO 31000:2018 and project risk management as stated in the PMBOK should be the focus. To achieve consistency in all the projects, PT HPI should institutionalize the application of risk checklists, risk matrices, and risk management plans in all projects. Effective risk management practices from comparative studies in other agro-industries, such as cassava-based enterprises, offer useful insights for developing palm oil mill projects.

The analysis of the processing of palm oil and the possible flaws in the supply chain (the first input and CPO output) will benefit future studies of the operational dimension of palm oil processing. It will support refining the risk management model related to the palm oil value chain. The combined application of ISO 31000:2018 and PMBOK in various agribusinesses would assist in the advancement of the foundational quantitative data within those frameworks, courtesy of Selango. This would shed light on risk management challenges in Indonesia's agribusiness.

REFERENCES

Azahari DH. 2024. Strategi pengembangan industri sawit Indonesia. Indonesia Center for Agriculture Social Economic and Policy (ICASEP), Ministry of Agriculture.

International Organization for Standardization. 2018. ISO 31000:2018 Risk Management – Guidelines. Geneva (CH): ISO.

 DOI: https://doi.org/10.24961/j.tek.ind.pert.2026.36.1.91

Iqbal UP, Nooney LK, Al Ghafri FSS, Daniel TM. 2025. Sustainable business practices in SMEs: A retrospective insight on catalysts and hurdles. *Cogent Business & Management.* 12(1):2456114.

Melly S and Purwaningrum P. 2018. Analisis dan perbaikan manajemen risiko rantai pasok gula merah. *Jurnal Teknologi Industri Pertanian* 28(1):61–71.

Paillin DB, Machfud, Hardjomidjojo H, Romli M. 2024. Agro-food supply chain risk assessment: A review based on technique and approach. *Journal of Applied Engineering and Technological Science* 5(2):892–908.

Pramana A, Zamaya Y, Ningsih AR, Hamzah FH, Zalfiatri Y, Kurnia D, Rimayanti N. 2022. Analysis of the supply chain of palm oil in PT Tribakti Sarimas, Riau. *Agrointek* 16(3):330–337.

Pratiwi NE, Immawan T, Handayani D, Fole A. 2024. Implementasi metode ISO 31000:2018 dalam perancangan mitigasi risiko pada proyek Depo Lokomotif Maros – Sulawesi Selatan. Integrasi: *Jurnal Ilmiah Teknik Industri* 9(2).

Project Management Institute. 2017. A Guide to the Project Management Body of Knowledge (PMBOK Guide). 6th ed. Newtown Square (US): Project Management Institute.

Putri FP, Marimin, and Yuliasih I. 2020. Peningkatan efektivitas dan efisiensi manajemen rantai pasok agroindustri buah: Tinjauan literatur dan riset selanjutnya. *Jurnal Teknologi Industri Pertanian* 30(3):338–354.

Rohimmah R, Wahyuda A, and Gunawan S. 2022. Analisis risiko dan strategi mitigasi risiko supply chain produk crude palm oil (CPO) (Studi kasus: PT XYZ). J@ti Undip: *Jurnal Teknik Industri* 17(2):92–101.

Soemardi BW, Kusuma B, Pribadi KS, Yuliar S. 2021. Technological capabilities of medium-sized contractors in Indonesia. *Journal of Construction in Developing Countries* 26(2):1–15.

Syarif HA, Betria I, and Muzafri A. 2024. Sosialisasi pembuatan batako geopolimer abu sawit dalam mewujudkan pembangunan rendah karbon di Desa Babussalam, Kabupaten Rokan Hulu. Mejuajua: *Jurnal Pengabdian Kepada Masyarakat* 4(2):373–381.

Titarenko R. 2025. Analysis of project risk management challenges from the perspective of the process approach. *PM World Journa*l 14(9).

Vargas DB and Campos LMS. 2022. Risk management: A parallel between ISO 31000 (2018) and the PMBOK Guide (2017). Proceedings of the International Conference on Industrial Engineering and Operations Management.

Wibowo Y, Herlina, Soekarno S, Wiyono AE, Prihani ST. 2023. Manajemen risiko pengembangan industri mocaf (*Modified Cassava Flour*) di Kabupaten Jember. *Jurnal Teknologi Industri Pertanian* 33(3):239–253.