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# A Case Study of Mitigating Risk of Invoice Payment Failure at Electricity Provider Company using the House of Risk Method

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**ABSTRACT**

Considering that a complicated or delayed invoice payment process can disrupt business operations, the company must establish mitigation measures to prevent such occurrences and minimize potential failures that may hinder future business processes. This context specifically involves collaboration with business partners or vendors providing services and materials. This research aims to map out the activities within the invoice payment business process, identify risk events and related risk agents, and formulate mitigation strategies to reduce their negative impact. The House of Risk (HOR) method is utilized to prioritize risks according to Aggregate Risk Potential (ARP) scores then the scores will be classified with a Pareto diagram. This study aims to offer actionable recommendations for risk mitigation, mostly in digitalization and automation of systems that can help lower the rate of document rejections and accelerate the overall payment cycle. Ultimately, these improvements will contribute to increased operational efficiency and reinforce vendor confidence, ensuring that high-value invoices are processed more reliably and promptly.



## 1. Introduction

In the business world, efficiency and accuracy in financial processes are key factors that can influence the continuity of a company's operations [1]. One of the most critical processes is the invoice payment process, which functions to ensure that payments to vendors or third parties comply with applicable terms and procedures. When this process does not run smoothly, it not only creates financial risks but can also damage the relationship between the company and its vendors, potentially harming the company's reputation.

The company in this study, tasked with providing electricity across Indonesia, works with thousands of vendors or stakeholders covering diverse regions and scopes of work. In line with its digital transformation initiatives and Financial Sustainability goals, it launched its digitalization program to enhance efficiency and speed up its payment processing for all sectors in the electricity provider company. The verification process for invoices is centralized at the company's head office, where different divisions handle submissions according to the originating units. Invoices are categorized into various categories with different contract types, stakeholders, and files needed, adding its the complexity of the process.

Sourced from internal historical data, which was collected from each team, indicates that the average rejection rate reached more than 20% of the processed invoices in the first semester of 2024. Rejected invoices made up more than 21% of the total value submitted, then led to significant payment delays, more than the ideal waiting time (around 4-9 days) after the initial submission. The statistical data revealed that repeated returns of incomplete files of invoice payment can cause delays of more than 30 days, far from the ideal waiting time.

To address and reduce the potential risks that could lead to payment process failures, this study proposes a mitigation strategy using the House of Risk (HOR) method, where the number of studies using this method in the finance field is still rarely found. The approach involves a detailed analysis

of each activity within the process, identifying and breaking down all risk events and related risk agents identified.

## 2. Methods

Risk can be defined as the consequence of uncertainty in relation to organizational objectives, involving upward and downward deviations that add substantial uncertainty in achieving those objectives. It is a situation resulting from variations, gaps in understanding information, and unpredictable threats [2]. Threats become more challenging as it affected by how complicated business processes are, by organizational rules applied, cost competitiveness, globalization, and external expectancy [3]. Another description of risk is something related to opportunities, losses, or uncertainties to an organization [4].

In conducting risk analysis across these categories, two methodological classifications are commonly used: qualitative and quantitative approaches [3]. One such quantitative method is the House of Risk (HOR). This method is conceptually derived from the House of Quality (HoQ), adopting its configuration and layout—complete with a roof and rooms—yet with a distinct purpose: analyzing the interrelationships among risks [5]. While in Failure Mode and Effect Analysis (FMEA), risk assessment is conducted by calculating the Risk Priority Number (RPN) based on severity and occurrence associated with the risk event. The House of Risk determines Severity based on risk events and Occurrence based on risk agents. A single risk agent may lead to multiple risk events, thereby necessitating the quantification of its Aggregate Risk Potential (ARP) [6].

Previous studies have applied methods such as FMEA, ANP, and DEMATEL, ISM for identifying and ranking risk causes in various contexts—for example, risk analysis in procurement process with interpretive structural modeling [7] risk analysis of power generator systems [8] risk mitigation using the HOR in blood supply chains [9], bug resolution in Android applications using FMEA [10], risk mitigation in the automotive industry through the HOR method [11], and procurement process risk mitigation combining ANP and HOR [12], using FMEA to asses risk in running event organization to increase security, safety and quality of event [13], also studies about implementing HOR to green supply chain of boogie product [14]. However, none of these studies have specifically addressed risk mitigation within the invoice payment process or within the financial operations domain. Therefore, this research aims to fill that gap by analyzing the causes of invoice document rejection in the payment process using the HOR methodology. This research involves a case study conducted at an electricity provider company in Indonesia.

The input data for this research comprises questionnaire results and expert discussions in the field of invoice processing and payment, specifically involving three respondents whose position is manager and senior officers with more than 5–10 years of experience. The questionnaires were distributed to experts and followed by group discussions to minimize potential subjectivity in answering, which led to response bias. Data collection and discussions were conducted from December 2024 to June 2025.

The research began with identifying business process activities, then was processed by the identification of risk events and their causal risk agents. These identifications were based on the evaluation of historical data and expert insights. The study employed three stages of questionnaire distribution: the first questionnaire aimed to assess correlation, impact level, and frequency; the second questionnaire captured the interrelationship among risk elements and causal agents; and the third consisted of a pairwise comparison to refine the values of impact and frequency.

The research method applied in this study is HOR. In the risk assessment phase, the collected data on impact and frequency levels from the questionnaires were analyzed. These values were then input into the HOR Phase 1 matrix, which maps the relationship between risk events and risk agents using scores of 1 (low), 3 (moderate), and 9 (high) [6], as shown in Figure 1. The Aggregate Risk Potential (ARP) values were computed by multiplying the frequency of each risk agent by the sum of the

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products of the impact score and the correlation score between each risk event and its associated agent [6]. ARP values were ranked and analyzed using a Pareto diagram, as shown in Figure 2, to identify the most critical risk agents among all causal factors. Risk agents with the highest ARP values were then brought back for expert discussion to formulate appropriate mitigation strategies. The analysis then proceeded to the HOR Phase 2, which involved evaluating the correlation between proposed mitigation actions and the identified risk agents.

| | | | | | | | | | | | | | | | | | RISK AGENT | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RISK EVENT | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | S |
| 1 | 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 8 |
| 2 | | 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 5 |
| 3 | | | 9 | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | 2 |
| 4 | | | | 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 |
| 5 | | | | | 9 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 7 |
| 6 | | | | | | | 3 | | | | | | | | | 3 | | | | | | | | | | | | | | | | | | | | | 4 |
| 7 | | | | | | | | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | 7 |
| 8 | | | | | | | | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | 8 |
| 9 | | | | | | | | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | 7 |
| 10 | | | | | | | | | | | 3 | 3 | 1 | | | | | | | 9 | | | | | | | | | | | | | | | | 6 |
| 11 | | | | | | | | | | | | 9 | 3 | 1 | 1 | | 9 | | | | | | | | | | | | | | 1 | | | | | 7 |
| 12 | | | | | | | | | | | | | 3 | 3 | 1 | | | | | | | | | | | | | | | | 1 | | | | | 6 |
| 13 | | | | | | | | | | | | | | | 3 | | | 3 | | | | | | | | | | | | | | | | | | 6 |
| 14 | | | | | | | | 3 | | | | | | | | 3 | | | | | | | | | | | | | | | | | | | | 2 |
| 15 | | | | | | | | | | | | | 1 | 1 | | | 9 | 1 | | | | | | | | | | | | | | 3 | | | | 7 |
| 16 | | | | | | | | | | | | | | | | | | 3 | 3 | | | | | | | | | | | | | | | | | 7 |
| 17 | | | | | | | | | | | | | | | | | | | | 9 | 3 | | | | 3 | | 1 | | | | | | | | | 8 |
| 18 | | | | | | | | | | | | | | | | | | | | | 9 | | | | | | | | | | | | | | | | 8 |
| 19 | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | 6 |
| 20 | | | | | | | | | | | | | | | | | | | | | | | 3 | | | | 3 | | | | | | | | | | 6 |
| 21 | 3 | | | | | | | | | | | | | | | | | | | | | | | 9 | | | | | | | | | | | | 9 | 9 |
| 22 | | | | | | | | | | | | | | | | | | | | | | | | 3 | 3 | 9 | 9 | | | | | | | | | | 6 |
| 23 | | | | | | | | | | | | | | | | | | | | | | | | | | | | 3 | 1 | | | | | | | | 6 |
| 24 | | | | | | | | | | | | | | | | | | | | | | | | 9 | | | | | | 1 | | | | | | | 6 |
| 25 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | 6 |
| 26 | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | 3 | 3 | | | | 6 |
| 27 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 3 | | | 5 |
| 28 | | | | | | | | | | | | | | | | | | | | 3 | | | | 9 | | | | | | | | | | | 9 | 9 | 8 |
| O | 6 | 7 | 4 | 5 | 6 | 3 | 4 | 6 | 5 | 7 | 6 | 7 | 6 | 6 | 4 | 4 | 9 | 6 | 4 | 9 | 6 | 4 | 5 | 9 | 7 | 7 | 8 | 3 | 3 | 1 | 2 | 5 | 5 | 5 | 8 | |
| ARP | 306 | 315 | 72 | 90 | 378 | 21 | 48 | 168 | 110 | 49 | 108 | 567 | 312 | 192 | 124 | 72 | 1188 | 276 | 84 | 1350 | 576 | 32 | 90 | 2025 | 294 | 378 | 640 | 54 | 18 | 6 | 12 | 260 | 90 | 75 | 1224 | |
| P | 12 | 10 | 26 | 21 | 8 | 32 | 30 | 17 | 19 | 29 | 20 | 7 | 11 | 16 | 18 | 27 | 4 | 14 | 24 | 2 | 6 | 31 | 22 | 1 | 13 | 9 | 5 | 28 | 33 | 35 | 34 | 15 | 23 | 25 | 3 | |

**Figure 1.** Risk Event and Risk Agent Matrix

| No | Code | M1 | M2 | M3 | M4 | M5 | M6 | M7 | M8 | M9 | M10 | M11 | M12 | ARP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | A24 | **9** | **9** | **9** | | | | | | | | | | **2025** |
| 2 | A20 | | **9** | **9** | | | | | | | | | | **1350** |
| 3 | A35 | | | **9** | | | | | | | | | | **1224** |
| 4 | A17 | | | | **9** | | | | | | | | | **1188** |
| 5 | A12 | | | **9** | | **9** | | | | | | | | **640** |
| 6 | A21 | | | | | | **9** | **9** | **9** | | | | | **576** |
| 7 | A27 | | | | | | | | **9** | | | | | **567** |
| 8 | A26 | | | | | **9** | | | | | | | | **378** |
| 9 | A5 | | | | | | **9** | **9** | | | | | | **378** |
| 10 | A2 | | | | **9** | | | | | **9** | | | | **315** |
| 11 | A13 | | | | | | | | | | **9** | | | **312** |
| 12 | A1 | | | **9** | | | | | | | **9** | | | **306** |
| 13 | A18 | | | **9** | | **9** | | | | **9** | | | | **294** |
| 14 | A25 | | | | | **9** | | | | | | **9** | **9** | **276** |
| | Effectivity Score | 18,225 | 30,375 | 52,551 | 13,527 | 14,292 | 8,586 | 8,586 | 10,287 | 5,481 | 5,562 | 2,484 | 2,484 | |
| | Difficulty Level | 4 | 4 | 3 | 4 | 4 | 4 | 4 | 4 | 3 | 4 | 4 | 3 | |
| | Ratio | 4,556 | 7,594 | 17,517 | 3,382 | 3,573 | 2,147 | 2,147 | 2,572 | 1,827 | 1,391 | 621 | 828 | |
| | Ranking | 6 | 2 | 1 | 5 | 3 | 7 | 8 | 4 | 9 | 10 | 12 | 11 | |

**Figure 2.** HOR Phase 2 Matrix

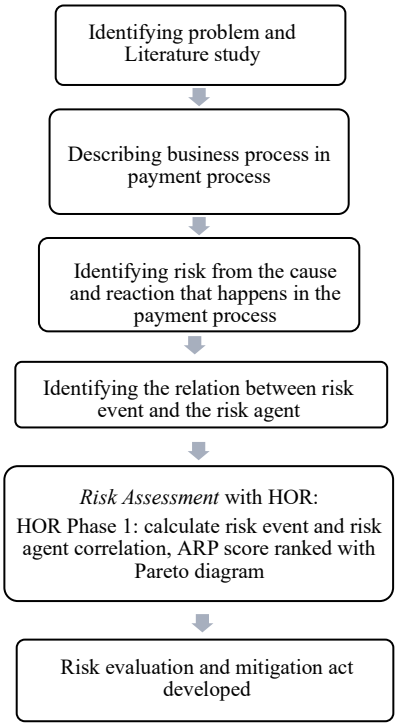


**Figure 3.** Research process flow

In Figure 3, the initial stages involve identifying the problem and conducting a literature review. This is followed by identifying risks based on potential causes and impacts that may occur in the payment process. Subsequently, relationships between each risk event and risk agent are identified using a questionnaire distributed to experts, supported by discussions to minimize opinion bias. Next, risk assessment is conducted using the House of Risk (HOR) method. In HOR Phase 1, correlations between risk events and risk agents are calculated using the Aggregate Risk Potential (ARP) formula, which incorporates severity and occurrence values along with assigned correlation scores. Resulting ARP values are then ranked from highest to lowest and analyzed through a Pareto diagram to identify risk agents with the greatest influence on risk events.

Afterward, discussions with experts are carried out to determine possible mitigation actions. HOR Phase 2 is performed to analyze correlations between selected risk agents and proposed mitigation actions. Results from the HOR Phase 2 produce prioritized mitigation actions to be recommended to management.

## 3. Results and Discussions

This study resulted in the identification of fourteen activities within the invoice payment process. Subsequently, twenty-eight risk events and thirty-five associated risk agents were identified through expert discussions. In HOR Phase 1, ARP values for the risk agents were calculated and ranked, and later classified through the application of a Pareto diagram. The research began with identifying business process activities, then was processed by the identification of risk events and their causal risk agents, which are outlined in Tables 1 and 2. Based on the Pareto analysis and further discussions with senior officers about risk response, where the result is that risks need to be minimized, also to confirm the number of risk agents needed to start formulating mitigation action, based on the highest ARP scores. Fourteen key risk agents were selected as the basis for formulating mitigation actions ranked 1$^{st}$ to 14$^{th,}$ with scores ranging from 2025 to 276.

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**Table 1.** Identified Risk Event

| Process | Risk Event | Code | Severity |
|---|---|---|---|
| Submit the approval of the payment report and upload it to the system | Error in reviewing the stated sum of payment | E1 | 8 |
| | Writing the wrong date in the minutes of the meeting | E2 | 5 |
| Selecting the GL Account | Incorrect selection of GL Account | E3 | 2 |
| Filling in the source of funds | Error in selecting the budget allocation post | E4 | 2 |
| Preparing the Statement Letter of Full Responsibility | Mistaken in writing down the job description on the letter form | E5 | 7 |
| | The responsible officer's name has not been updated | E6 | 4 |
| Hand in the physical file to the Invoice Receiver | Hardcopy documents not received from the user | E7 | 7 |
| Rejecting the invoice payment document | Error in checking the hardcopy invoice | E8 | 8 |
| Comparing physical file content to its digital file content | Hardcopy documents differ from the softcopy, but the invoice has already been processed/paid | E9 | 7 |
| Validating the tax invoice | Mistake in verifying the consistency between the budget plan tax amount and the state income tax files, causing a difference in the billed amount | E10 | 6 |
| | Error in checking the matched tax code option | E11 | 7 |
| Calculating the applicable tax rate and selecting the appropriate VAT and Income Tax codes | Inaccurate selection of VAT code | E12 | 6 |
| | Incorrect selection of the income tax code | E13 | 6 |
| Reviewing the payment recommendation memo | PIC is unaware of the need to check the updated information of the responsible officer's name | E14 | 2 |
| Performing invoice verification | Error in applying the VAT code | E15 | 7 |
| | Error in checking the use of the tax code and its amount | E16 | 7 |
| | Error in checking discrepancies in billing amounts | E17 | 8 |
| | Failure to round billing amounts in the system | E18 | 8 |
| | Error in selecting the GL Account during rounding | E19 | 6 |
| | Error in checking penalty amounts on the invoice | E20 | 6 |
| | Mistake in selecting the correct payer bank code | E21 | 9 |
| Review invoice documents | Error in verifying the completeness of the file required | E22 | 6 |
| | Delay in verifying the invoice | E23 | 6 |
| Approval invoice verification | Error in creating the payment plan request | E24 | 6 |
| | Delay in approving the invoice verification | E25 | 6 |
| Performing payment merging and executing the payment | Underpayment or overpayment occurred | E26 | 6 |
| | Error in resubmitting the payment | E27 | 5 |
| | Payment failure | E28 | 8 |

**Table 2.** Identified Risk Agent

| Risk Agent | Code | O | Risk Agent | Code | O |
|---|---|---|---|---|---|
| Mismatch between written and numeric amounts with contract billing value | A1 | 6 | Tax amount changed/different, resulting from an error in the system | A19 | 4 |
| Completion of the work report doesn't match the reference | A2 | 8 | The billing amount has a difference | A20 | 9 |
| Doesn't know the code account number | A3 | 4 | Inattention in identifying differences in application data | A21 | 6 |
| Unknown the budget code | A4 | 5 | Verifier lacked knowledge of the budget code | A22 | 4 |
| Missed to double check on the contract | A5 | 6 | Penalty amount in the system differs from its original amount | A23 | 5 |
| Confusion about the required input in the application | A6 | 3 | Payment bank written on the receipt dissimilar from the system | A24 | 9 |

| Risk Agent | Code | O | Risk Agent | Code | O |
|---|---|---|---|---|---|
| Delay in the change of account when the official replaced | A7 | 4 | The revised contract about the payment requirement can't be read | A25 | 7 |
| Incomplete physical file | A8 | 6 | Didn't know the main objective of uploading payment requirement documents | A26 | 7 |
| The wrong document file was submitted. | A9 | 5 | Carelessly reading the content of document files | A27 | 8 |
| Incomplete file assumed complete. | A10 | 7 | An overwhelming number of invoices and the late submission of invoices | A28 | 3 |
| Rounding for Value Added Tax (VAT) | A11 | 6 | Unawareness of invoices that were rejected by the payment team | A29 | 3 |
| No billing value review in the contract | A12 | 7 | Lack of communication from the unit to the verifier | A30 | 1 |
| Tax invoice code not validated. | A13 | 6 | Lack of communication among verifier team members | A31 | 2 |
| Miss checked the vendor status. | A14 | 6 | Inaccuracy in the VAT code used | A32 | 5 |
| The person in charge didn't verify the job type | A15 | 4 | Different input of penalty amount in the system compared to the digital file | A33 | 5 |
| Delay in the change of account when the official replaced | A16 | 4 | Lack of communication between verification process members and payment process members | A34 | 5 |
| Wrong check of the tax code and VAT code | A17 | 9 | Incorrect bank data | A35 | 8 |
| Supporting tax document not filled. | A18 | 6 | | | |

**Table 3.** Formulated Mitigation Act

| No | Mitigation Act | No | Mitigation Act |
|---|---|---|---|
| 1 | Enhance the reliability of the OCR system to detect discrepancies in data. | 7 | Implementing OCR technology to extract information from contract documents. |
| 2 | Improving the utilization of the application system by developing digital receipts integrated with digital stamp duty and digital signature | 8 | Enhancing the system to automatically detect discrepancies between the contract value and the value entered in the application |
| 3 | Providing training or evaluation sessions for vendors and users to increase accuracy in document preparation and processing. | 9 | Conducting evaluations for vendors and users, particularly related to tax documentation requirements. |
| 4 | Upgrading the application system to include detection alerts when the physical invoice code differs from the code recorded | 10 | Utilizing an integrated application for issuing work reports connected with the payment system (currently under development). |
| 5 | Developing a technical guidance manual or standard operating procedures outlining key steps in the invoicing process. | 11 | Integrating the latest payment requirement criteria into the system to support automated document verification |
| 6 | Leveraging contract data integration with relevant applications, including SAP systems | 12 | Establishing standardized quality requirements for uploaded files |

A total of twelve mitigation strategies were proposed, collected from discussions with managers and senior officers on duty, as outlined in Table 3, along with an analysis of their impact on the respective risk agents. Based on the analysis conducted in the HOR Phase 2, five mitigation actions with the highest effectiveness ratios were selected and recommended to company management. Which

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is to hold training sessions for stakeholders and office users to improve capabilities in document preparation, integrating the use of the application system by implementing digital receipts with application for digital signature or duty stamp, propose and implement fixed technical guidelines outlining the procedures, enhances the optical character recognition (OCR) to validate and detecting differences between invoices value from uploaded document with the value submitted to system, upgrading system to recognizing differences between code from tax document with one that inputted to application. The methodology of this study aligns with previous research for mitigating risk in business processes utilizing the House of Risk method, including those that combine it with other approaches such as FMEA or ANP. However, the object of analysis in this study focuses specifically on administrative processes, particularly in the payment domain, while emphasizing the interrelationships between various process elements, where research related to this object is still very few.

## 4. Conclusion

This study aims to develop mitigation strategies for risks arising from identified risk agents within the vendor invoice payment process in the company. The main outcome of this research is the identification of five key mitigation actions derived from the ranking of critical failure causes in the process of invoice payment, assessed using the HOR methods. This analysis is supported by using a Pareto diagram, which assists in classifying the most significant risk agents among the identified.

The implementation of proposed mitigation measures not only reduces the potential for process failure but also encourages end-to-end system integration, strengthens human resource capabilities through regular training, and fosters a more standardized and efficient billing process. The findings of this study provide a data-driven and technically structured foundation for a company to establish a comprehensive risk management system for invoice payments. In addition to contributing to improvements in terms of timeliness, cost-efficiency, and quality, the mitigation efforts also support the sustainability of vendor relationships and ensure long-term operational stability.

For future research, application of the DEMATEL method may be considered to better quantify if the researcher wants to count in interrelationships [15] between risk elements that need to develop pairwise comparison questionnaires. Furthermore, the inclusion of a risk matrix that visualizes zones of mitigation urgency could assist management in prioritizing which risks require immediate action, thereby facilitating more effective decision-making in risk management.

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