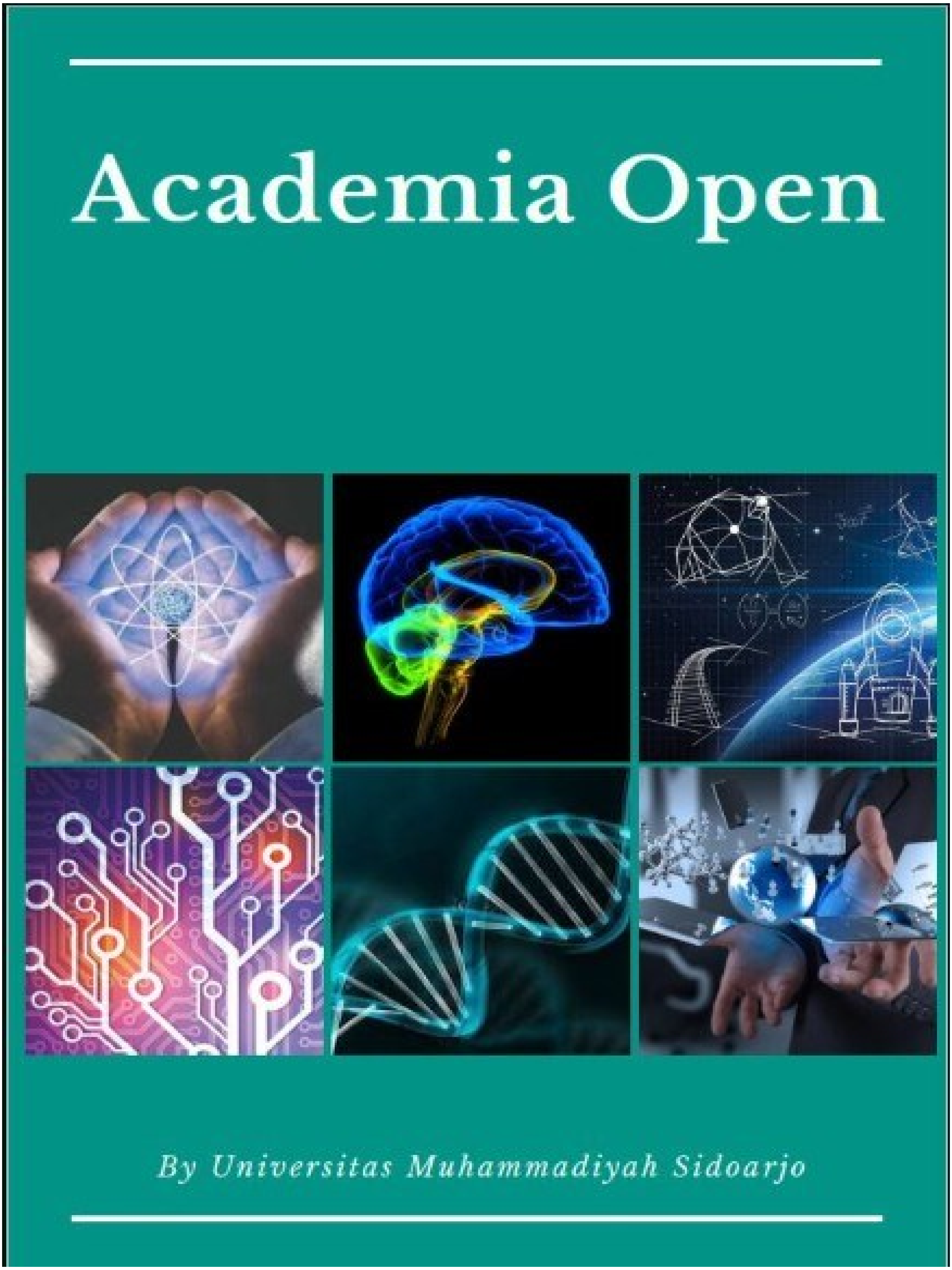
Academia Open

Vol. 10 No. 2 (2025): December
DOI: 10.21070/acopen.10.2025.11690



ISSN 2714-7444 (online), https://acopen.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

Academia Open

Vol. 10 No. 2 (2025): December
DOI: 10.21070/acopen.10.2025.11690

Table Of Contents

ISSN 2714-7444 (online), https://acopen.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

Originality Statement

The author[s] declare that this article is their own work and to the best of their knowledge it contains no materials previously published or written by another person, or substantial proportions of material which have been accepted for the published of any other published materials, except where due acknowledgement is made in the article. Any contribution made to the research by others, with whom author[s] have work, is explicitly acknowledged in the article.

Conflict of Interest Statement

The author[s] declare that this article was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Copyright Statement

Academia Open

Vol. 10 No. 2 (2025): December
DOI: 10.21070/acopen.10.2025.11690

EDITORIAL TEAM

Academia Open

Vol. 10 No. 2 (2025): December
DOI: 10.21070/acopen.10.2025.11690

Article information

Check this article update (crossmark)

Check this article impact (*)

Save this article to Mendeley

(*) Time for indexing process is various, depends on indexing database platform

Academia Open

Vol. 10 No. 2 (2025): December
DOI: 10.21070/acopen.10.2025.11690

Mitigating Furniture Supply Chain Risks: A House of Risk Approach

Mengurangi Risiko Rantai Pasokan Mebel: Pendekatan Rumah Risiko

Mutiara Rahmi, muti.rahmi333@gmail.com (*)

Industrial Engineering Study Program, Universitas Pembangunan Nasional Veteran Jawa Timur, Indonesia

Dira Ernawati, dira.ti@upnjatim.ac.id

Industrial Engineering Study Program, Universitas Pembangunan Nasional Veteran Jawa Timur, Indonesia

(*) Corresponding author

Abstract

General Background The furniture manufacturing industry relies on complex production processes and natural raw materials, creating vulnerability to supply chain disruptions that threaten production continuity. **Specific Background** PT XYZ, a furniture manufacturer in East Java, experiences recurring problems in its upstream supply chain, particularly delays, material inconsistencies, and operational disruptions related to wood-based raw materials used in table production.**Knowledge Gap** Previous studies on furniture supply chains have largely applied general risk management approaches, while structured and quantitative applications of the House of Risk method in upstream furniture supply chains remain limited. **Aims** This study aims to identify critical supply chain risks, prioritize dominant risk agents, and formulate mitigation strategies using the House of Risk framework. **Results** The analysis identifies 21 risk events and 26 risk agents, with 11 dominant risk agents accounting for more than 80% of aggregate risk potential, primarily related to human error, material variability, storage conditions, coordination issues, and incomplete drying of wood. **Novelty** This study demonstrates the structured application of the House of Risk method in the upstream segment of the furniture supply chain, an area that has received limited empirical attention. **Implications** The findings provide practical guidance for furniture manufacturers to strengthen supply chain resilience through targeted mitigation strategies such as training, standardization, digital coordination, and material quality control, while also contributing empirical evidence to supply chain risk management literature.

Highlights:

- Dominant supply chain vulnerabilities originate from human error, raw material variability, and storage conditions.
- A small group of risk agents accounts for the majority of upstream supply chain disruptions.
- Structured mitigation prioritization supports systematic risk handling in furniture manufacturing operations.

Keywords: House of Risk, Supply Chain Risk, Furniture Manufacturing, Risk Mitigation, Upstream Supply Chain

Published date: 2025-12-19

Vol. 10 No. 2 (2025): December
DOI: 10.21070/acopen.10.2025.11690

Introduction

The furniture industry has high growth potential and contributes significantly to increasing revenue and national economic growth. The competitive advantage of the Indonesian furniture industry lies in its distinctive designs and the use of natural raw materials, which are unique compared to products from other countries. However, the characteristics of this industry, which involves limited natural raw materials, complex production processes, and high demand for customized products, make supply chain management a challenge. Uncertainty in meeting customer demand can create risks that directly impact operational efficiency and company performance [1].

Several previous studies have discussed the importance of risk management in the supply chain to improve the competitiveness and efficiency of the manufacturing industry, particularly furniture [1] stated that the furniture and crafts industry is a strategic sector that produces products with high added value and is able to compete in the global market, supported by raw materials such as wood, rattan, and bamboo. Meanwhile, emphasized that in facing increasingly fierce competition, companies are required not only to produce innovative products but also to maintain consistent quality, timely delivery, and production efficiency [2]. added that implementing a risk management strategy is essential to reduce the possibility of disruptions in the supply chain that could result in production delays [3].

However, these studies are still limited to a general approach to risk management without focusing on structured and quantitative risk identification and mitigation methods. Few studies have specifically implemented the House of Risk (HoR) model in the context of the furniture industry, particularly in the early stages of the supply chain related to dependence on raw materials from suppliers [4]. However, the HoR approach has the advantage of helping companies proactively identify and prioritize risks based on severity and frequency of occurrence, and establish efficient and high-impact mitigation strategies. This research is important because it addresses a gap in previous studies by focusing specifically on the application of the House of Risk (HOR) method to risk management in the upstream segment of the furniture industry supply chain—an area that remains underexplored. The study takes PT XYZ as a case example, a furniture manufacturing company based in Sidoarjo, East Java, which produces a variety of products such as tables, chairs, cabinets, and mirrors. The company frequently encounters supply challenges related to key raw materials like mindi, mahogany, and teak. Delays in delivery and inconsistencies in material specifications have led to recurring production bottlenecks, with failure rates surpassing acceptable limits. The objective of this study is to identify key risks in the raw material supply chain, analyze their root causes, and propose targeted mitigation strategies using the HOR framework. By doing so, the research not only offers practical solutions for PT XYZ but also contributes to the academic literature by demonstrating how the HOR method can be effectively applied to upstream supply chain risk management in the furniture manufacturing sector—a novel context that enhances the method's relevance and applicability.

Method

The research was conducted over a six-month period, focusing primarily on the raw material supply chain for tableware products. The aim of this study was to identify risk drivers and design risk mitigation strategies using the House of Risk (HOR) method. The initial step in the research was the collection of primary and secondary data. Primary data was obtained through direct field observations, interviews, and questionnaires distributed to parties directly involved in the supply chain, particularly the purchasing, warehouse, production, and quality control departments. Secondary data was obtained from company documentation, such as production reports, raw material delivery records, and product defect data. Next, the supply chain business processes were identified, including the flow of raw materials from suppliers to the production process. The primary focus of this research was on the upstream part of the supply chain, from suppliers to the production process. This study did not address financial aspects or information flow in detail. Following the identification process, risk events and risk agents that have the potential to disrupt the supply chain are identified. Risk assessment is conducted using the House of Risk phase 1 method . In this stage, respondents are asked to provide scores on three main parameters: severity (impact level), occurrence (frequency of occurrence), and relationship (degree of relationship between the risk event and the risk agent). The scale used ranges from 1 to 10 for severity and occurrence, and 0, 1, 3, and 9 for the correlation (Rij) . The collected data is then used to calculate the Aggregate Risk Priority (ARP) value for each risk agent. The next step is to conduct an 80/20 Pareto analysis to determine priority risk agents requiring mitigation strategies. Risk agents categorized as high priority will be further analyzed in House of Risk phase 2. In this stage, researchers identify relevant mitigation actions, assess their effectiveness against the risk agents, and calculate the Effectiveness to Difficulty Ratio (ETD). Mitigation strategies are then prioritized based on the highest ETD value . The entire process was analyzed using Microsoft Excel software for numerical data processing and visualizations such as Pareto charts. The analytical method used was descriptive-quantitative, using a case study approach to illustrate real-world conditions and provide recommendations tailored to the company's situation.With these stages and methods, this research is expected to produce appropriate and applicable mitigation strategies to address risk issues within PT XYZ supply chain, particularly in the supply of raw materials for tables.

Academia Open
Vol. 10 No. 2 (2025): December
DOI: 10.21070/acopen.10.2025.11690

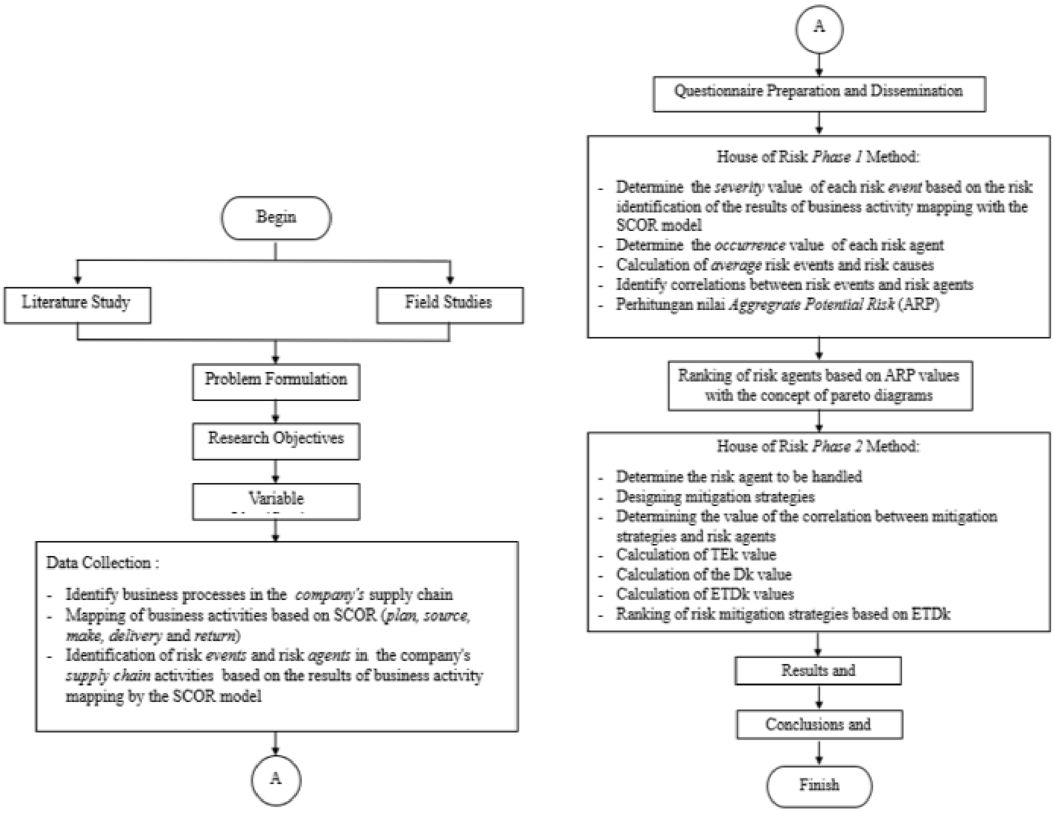


Figure 1. Flowchart

Result and Discussion

A. Data Collection

The data collection in this study includes primary data and secondary data. Primary data was obtained directly throughinterviews with the company based on risk mapping in supply chain activities (supply chain), which refers to the SCOR framework (Supply Chain Operations Reference) . The respondents in this study consisted of three parties who played an important role in the company's supply chain, namely the Head of the Division Supply Chain, Production Staff, and Procurement Staff at PT XYZ.). The following is a mapping of PT XYZ's business activities based on the SCOR concept. The grouping of a company's supply chain activities based on the SCOR model is shown in Table I below.

Table 1. Activity Mapping Concepts Supply Chain Companies Based on The SCOR model

Major Process	***Sub Process***	***Detail Activity***
Plan	Financial Planning	Adjusting the company's financial planning with the planning of raw material needs or the preparation of the RAB
	Raw Material Procurement Planning	Planning the needs of *primary* and *secondary* raw materials
	Inventory Planning & Control	Plan the type, quantity, and time of ordering raw materials and semi-finished goods
Source	Procurement Process	Selection of company suppliers for the procurement of raw materials
		Incoming Materials receives materials from suppliers, conducts physical and administrative checks (roadsheets, invoices) and records receipts in the system (if any).
		Storage of Raw Materials/Materials (Inventory), storing raw materials in warehouses according to categories, compiling a FIFO (First In First Out) or LIFO system, and maintaining the quality of raw materials during storage.

ISSN 2714-7444 (online), https://acopen.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

Make	Production Process	Maintenance on Machinery/Facilities in the Production Process, performing routine maintenance and repair of production machinery. Ensure there is no downtime due to engine damage, develop a preventive maintenance schedule.
		CPP (*Central Part Preparation*) section, cutting, forming, or processing raw materials becomes the main part of the product by using machines such as saws, CNC, and then initial dimensional and quality checks.
		Parts Assembly (*Assembling*), arranging and assembling parts into the form of the final product using tools such as drills, glues, couplers.
		Sanding is like smoothing the surface of the product with a sanding machine or manual and then removing defects on the surface such as coarse fibers or protrusions.
		The *Finishing part* here is like giving a final layer such as paint, pelitur, or laminate and then entering the drying and packaging process.
Delivery	Shipping Process	Delivery of products to buyers, packaging products and loading to vehicles, and arranging delivery logistics (addresses, schedules).
Return	Return Process	Raw material return process in case of delivery error from the supplier

This study successfully identified 21 risk events that have occurred and caused disruptions to the company's supply chain operations. The risk events in the supply chain are described in Table 2 below:

Table 2. Risk Event

Business Process	***Sub Process***	***Risk Event***	**Code**
Plan	Financial Planning	Incompatibility between the company's financial planning and the planning of raw material needs	E1
	Raw Material Procurement Planning	Shortage of wood raw materials and other mixed materials	E2
	Inventory Planning & Control	Orders from uncertain consumers	E3
Source	Procurement Process	There is a dependence on raw material needs to one of the suppliers	E4
		Suppliers are unable to meet large demand	E5
		Materials from *suppliers* do not meet specifications (quality, quantity, and type)	E6
		Damaged material in storage in the warehouse	E7

ISSN 2714-7444 (online), https://acopen.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

Academia Open
Vol. 10 No. 2 (2025): December
DOI: 10.21070/acopen.10.2025.11690

Business Process	***Sub Process***	***Risk Event***	**Code**
Make	Production Process	Damage to *the Fingerjoint* machine during production	E8
		Unsymmetrical or unstrong joints cause incompatibilities in shape and function	E9
		Wood drying is constrained by high moisture content in wood	E10
		Wood cutting still found cork wood blades	E11
		Imprecise cutting causes the size to be not up to specification	E12
		Perfectly assembled wood assembly	E13
		An error occurred in the assembly process	E14
		Products that are supposed to be defective pass inspection to the next process	E15
		The smoothing process is uneven throughout the wood	E16
		Uneven staining results	E17
		The staining result is not durable and easily peels off	E18
		There is an open hole formed as a result of the spray on the paint carrying oxygen	E19
Deliver	Shipping Process	Damage to the product ordered by the *buyer* during transportation	E20
Return	Return Process	Late process of returning materials that are not in accordance with the *supplier*	E21

After identifying and understanding the risks that arise in supply chain activities, the next step is to identify the causes of the risk events. Twenty-six risk factors have been identified as contributing to these risks. The causes of risk in the supply chain are presented in Table 3 below.

Table 3. Risk Agent

Risk Event	**Code (Ei)**	**Risk Causes (*Risk Agent*)**	**Code (Ai)**
Incompatibility between the company's financial planning and the planning of raw material needs	E1	Lack of coordination between the finance department and the production department	A1
		Sudden changes in production schedules due to certain conditions	A2
Shortage of wood raw materials and other mixed materials	E2	Delay in delivery from suppliers	A3

ISSN 2714-7444 (online), https://acopen.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

Risk Event	**Code (Ei)**	**Risk Causes (*Risk Agent*)**	**Code (Ai)**
Orders from uncertain consumers	E3	Lack of communication with *buyers* regarding order requests	A4
Dependence of raw materials on one supplier	E4	Binding long-term cooperative relationship	A5
Suppliers are unable to meet large demand	E5	Limited supplier production capacity	A6
		Operational disruption on the part of the supplier	A7
Material from supplier does not meet specifications	E6	Specification requests are not clearly written in the purchase order	A8
		Lack of initial inspection of incoming materials	A9
Damaged material in storage in the warehouse	E7	Storage that does not meet material standards	A10
Breakdown of the Fingerjoint machine	E8	Poor and non-standard storage techniques	A11
Unsymmetrical or unstrong joints	E9	The wide variety of products worked on	A12
		The wood used in the production process has different thicknesses	A13
Wood drying constrained by high moisture content	E10	The wood material used has not dried completely	A14
Wood cutting still found cork wood blades	E11	Operator inaccuracy/*human error*	A15
Imprecise cutting	E12		
Wooden assembly does not fit perfectly	E13	The wood material used is not suitable for size	A16
Faults in the assembly process	E14	Not optimal use of adhesives or aids	A17
Defective products pass inspection	E15	Different QC member capabilities	A18
		Disability criteria are not explained in detail	A19
Uneven refinement process	E16	The surface of the wood has a natural roughness that is not adjusted	A20
Uneven staining results	E17	Composition errors in the dye material used	A21
The result of staining peels off easily	E18	Differences in color pigment suppliers	A22

DOI: 10.21070/acopen.10.2025.11690

Risk Event	**Code (Ei)**	**Risk Causes (*Risk Agent*)**	**Code (Ai)**
Holes due to spray paint carrying oxygen	E19	*The spray gun* is not calibrated to the correct pressure	A23
Product damage during transport	E20	Impact occurs during product transfer	A24
		The transportation used is not feasible	A25
Late process of returning materials from suppliers	E21	Unfavourable weather changes	A26

B. Preparation and Distribution of Questionnaires

After an analysis of the production system and supply chain business activities at PT XYZ and the identification of risk events (risk event) and its causative factors (risk agent), the next step is to make the first questionnaire, which is a questionnaire severity addressed to three respondents, namely the Head of the Division supply chain management, procurement staff, and production staff to provide a value of the severity of the cause of the risk that occurs. Continued, the second questionnaire is the questionnaire occurrence addressed to the same three respondents, namely the Head of the Division supply chain management, procurement staff, and production staff to provide value for the emergence of risk causes to risk events. Furthermore, the third questionnaire was addressed to one respondent, namely the head of the division supply chain management to identify the relationship (correlation) carried out by researchers to find out how much influence the cause of risk events is (risk agent) against risk occurrences (risk event). Then to support the second stage of the House Of Risk A fourth questionnaire is needed which is addressed to 1 respondent, namely the Head of the Division supply chain management to define relationships (correlation) Among the causes of risk occurrence (risk agent) with risk mitigation strategies (risk agent). Identify relationships (correlation) researchers are carried out to find out how much influence risk mitigation strategies have in addressing the causes of risk events (risk agent). Finally, the fifth questionnaire was used to see the degree of difficulty (Dk) which is the level of difficulty of the company in implementing risk mitigation strategies. This fifth questionnaire was addressed to 1 respondent, namely the head of the division supply chain management.

C. House Of Risk Phase 1

Once the risk is identified, the next step is to conduct an analysis using the House of Risk (HOR) level 1. This process includes an assessment of severity, likelihood of occurrence, relationship, and scoring Aggregate Risk Potential (ARP) . In this stage, the main focus is to find the most detrimental risks that have the potential to affect the company's production continuity. Ranking results of the Aggregate Risk Potential (ARP) will be used as a reference in formulating risk mitigation measures in House of Risk (HOR) level 2 [9].

1. Assessment of Severity Value by Respondents

At this stage, the determination of the value severity to determine the severity of each risk event that has been identified in the company's activities using the SCOR model. Value determination severity carried out by distributing questionnaires to parties related to the activity supply chain company. The following is the respondent data for the assessment severity and occurrence [10]. The assessment of the level of impact (severity) is carried out based on the parameters of the impact level scale 1 to 10.

2. Assessment of Occurrence Value by Respondents

At this stage, a value of the possibility of risk causes is determined (occurrence). Event frequency value (occurrence) used to analyze how likely a failure is (potential failure) occurs in a process activity or in an existing system. So that with the assessment of the frequency of events (occurrence) can be an evaluation of the probability (possibility) of failure so that relevant mitigation efforts are immediately carried out. In the process of identifying possible risk causes, researchers apply a scale of 1 to 10 [9].

3. Determination of correlation (relationship) between risk event and risk cause (risk agent)

In this step, an evaluation of the relationship between the emergence of risks (risk event) with risk factors (risk agent) [12]. If a risk factor can result in a risk event, then it can be stated that the two are interconnected. In studies of the relationship between risk events (risk event) and the cause of the risk (risk agent), used depictions with scales 0,1,3,and 9.

4. Calculation of Aggregate Risk Priority (ARP) Value

After an assessment of the severity of the impact of the risk event (severity), the level of chance of the emergence of risk causes (occurrence) and correlation between risk events (risk event) with the cause of the risk (risk agent) . Next,

ISSN 2714-7444 (online), https://acopen.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

calculations will be carried out Aggregate Risk Potential (ARP) to determine the priority of the risk causes that need to be addressed first. Below is the ARP formula [9].

$$ARP_j \quad = O_j \Sigma S_i R_{ij} \qquad (1)$$

D. Risk Agent Ranking Based on ARP Value and Pareto Diagram Concept

After ranking on the Aggregate Risk Priority (ARP) is completed, the next step is to calculate the percentage and cumulative percentage of each risk cause (risk agent). The goal is to make it easier to compile pareto diagrams, The creation of a pareto chart aims to make it easier to determine the priority order of risk causes. In this study, the pareto diagram is applied with the principle of 80%:20%, which indicates that the risk causes that are in the 80% category are seen as the main priority to design risk mitigation strategies through the House of Risk (HOR) phase 2. From the data recap above, the data is presented in the form of a pareto diagram. The following is a pareto diagram Figure 2 for the 26 risk agents are shown in Figure 2.

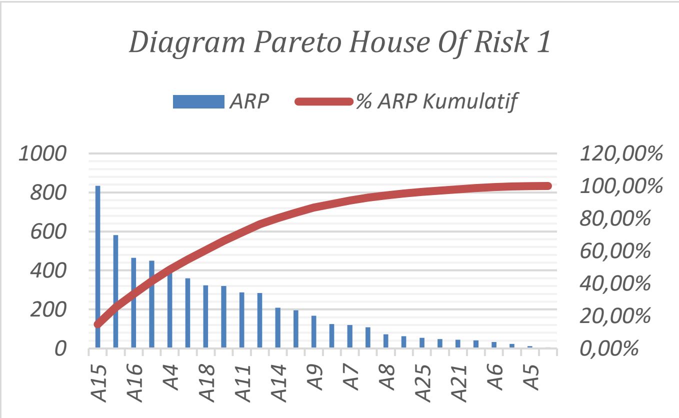


Figure 2. Pareto Diagram

Then based on the processed data, the total ARP value for all risk causes is 5620. It is known that there are 11 risk causes that are classified as the dominant group of 80% or priority groups, with an ARP value of 4505 which is 80.16% of the total ARP value that causes risk. The risk agents included in the Pareto diagram concept are shown in the following table 4 :

E. House of Risk Phase 2

After completing the first phase of HOR, the next step is to proceed to the second phase of HOR. In the second phase of HOR, a mitigation plan will be designed to avoid the emergence of risk factors in the company's supply chain activities. The results of HOR phase 1 will be used as the basis for the completion of this HOR phase 2 [13]. The mitigation plan chosen will also consider the overall effectiveness and difficulty level of each strategy if implemented by the company

1. Determination of Risk Agents to Be Handled

Then based on the processed data, the total ARP value for all risk causes is 5620. It is known that there are 11 risk causes that are classified as the dominant group of 80% or priority groups, with an ARP value of 4505 which is 80.16% of the total ARP value that causes risk.

2. Risk Mitigation Strategy Design

At this stage, the design of a risk mitigation strategy is carried out by first looking at the causes of the risk (risk agent) priorities.

3. Determination of the Correlation Value between Risk Agents and Mitigation Strategies

At this stage, a correlation assessment was carried out between mitigation strategies and risk agents using HOR 2. This correlation aims to ensure that any mitigation strategy designed has a significant influence on the risk agents (sources of risk) that have been identified [14]. Correlation assessment is determined using a likert scale as in the correlation assessment between risk events and risk agents, used depictions with scales 0,1,3,and 9.

4. Calculation of Total Effectiveness of Action (TEk)

At this stage, the Total calculation will be carried out Effectiveness of Action (TEk) of 11 mitigation strategies. Total calculation calculation Effectiveness of Action (TEk) is obtained from the result of multiplication between Aggregate Risk Potential (ARP) of each risk agent with a correlation value between the risk agent and the mitigation strategy [15].

$$TE_k \quad = \sum ARP_j E_{jk} \qquad (2)$$

ISSN 2714-7444 (online), https://acopen.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

5. Weighting of Mitigation Action Difficulty Level (Dk)

After getting Total Effectiveness of Action (TEk) from each mitigation strategy, the next stage will be carried out difficult of performing action (Dk). The Dk value expresses the Difficulty Level of each mitigation strategy. With difficulty level of mitigation actions using a scale of 3, 4, 5

6. Calculation of Effectiveness to Difficulty of Ratio (ETDk).

The ETDk value expresses the ratio between the value of the effectiveness of the mitigation action and the level of difficulty of each risk mitigation action [6].

$$ETDk = \frac{TE_k}{D_k} \quad (3)$$

7. Risk Mitigation Strategy Ranking

After calculating the ETDk value, the next stage will be a ranking of mitigation actions. This ranking is carried out based on the results of calculating the level of effectiveness and difficulty of each mitigation action [17]. Rankings are carried out from the largest to the lowest ETDk value. The following is the recap of the evaluation of mitigation actions are shown in Table 4 below.

Table 4. Recap of the Results of the Mitigation Action Evaluation

Rangking	Code (PA)	Proposed Mitigation Strategy	TEk	Dk	ETDk
1	PA1	Periodic job training and job skills certification	10422	3	3474
2	PA8	Monitoring the moisture content of wood using *the Moisture Content Meter*	5586	3	1862
3	PA5	Application of digital communication systems such as CRM or Google Form for order updates	4752	3	1584
4	PA2	Standardization of raw material specifications to *suppliers*	5931	4	1483
5	PA11	Require a moisture content test (*MC test*) before the wood is processed	4752	4	1188
6	PA6	ERP system integration between finance and production divisions	3240	3	1080
7	PA9	Technical training on raw material storage for warehouse staff	2592	3	864
8	PA10	Creation of specific *job sheets* per product model	2556	3	852
9	PA4	Warehouse layout and storage ventilation rearrangement	4050	5	810
10	PA3	Calibrate measuring instruments and cut regularly	1977	5	395
11	PA7	Implementation of standardized QC inspection forms (*checklist*)	972	3	324

Based on Table 4 above, the ranking results for each mitigation action are obtained. The higher the value of mitigation actions, the greater the impact. This can be seen from how much the value Effectiveness to Difficulty of Ratio to the level of difficulty [14]. Of the 11 mitigation actions that have been ranked, these are risks that have a major impact on activities supply chain at PT XYZ at the time of producing its table products.

F. Analysis of Results and Discussion

After data processing is carried out from HOR phase 1 which includes risk identification to HOR phase 2 which includes risk mitigation. The results that can be obtained are that in HOR phase 1 there are 21 risk events caused by 26 risk causes in activities supply chain company. Furthermore, at the risk analysis stage, a value is obtained aggregate risk potential (ARP) of the 26 risk causes and in accordance with the principle of the Pareto diagram, which is 80%: 20%, then the priority of the problem that must be solved is the risk with a cumulative percentage of up to 80% of the ranking of the ARP value of each of the largest to smallest risks, as many as 11 of the most dominant risk causes are obtained.

Of the 11 dominant risk causes, then in phase 2 of HOR, mitigation action is designed to minimize the occurrence of existing risk cause s [11]. From these 11 mitigations, the value of Effectiveness to Difficulty of Ratio (ETDk) to get mitigation priority. Determination of the value determined Effectiveness to Difficulty of Ratio (ETDk) is obtained from the value of the effectiveness of each mitigation action (TEk) and the difficulty level of each mitigation action (Dk). The following are priority risk mitigation actions for activities supply chain company according to the ranking results. The risk mitigation actions and strategy explanations in Table 5 below.

Vol. 10 No. 2 (2025): December
DOI: 10.21070/acopen.10.2025.11690

Table 5. Risk Mitigation Actions and Strategy Explanations

Rangking	Code (PA)	Proposed Mitigation Strategy	ETDk	Strategy Explanation
1	PA1	Periodic job training and job skills certification	3474	This strategy is useful to help improve the operator's knowledge and technical skills in the production process such as cutting, assembly, and checking the dimensions of the table and reduce the possibility of errors stemming from ignorance or bad habits at work.
2	PA8	Monitoring the moisture content of wood using *the Moisture Content Meter*	1862	This strategy is useful to ensure that wood has met the optimal moisture content before entering production and avoids the risk of cracking, shrinkage, or warping due to the wood being wet
3	PA5	Application of digital communication systems such as CRM or Google Form for order updates	1584	This strategy is useful for ensuring all order information is stored in real-time and documented and avoiding production errors due to miscommunication.
4	PA2	Standardization of raw material specifications to *suppliers*	1483	This strategy is useful for *suppliers* to meet predetermined thickness specifications, which can reduce the possibility of variations in wood thickness that cause imbalances and mismatches between table components.
5	PA11	Require a moisture content test (*MC test*) before the wood is processed	1188	This strategy is useful for warehouse staff in understanding how to arrange wood neatly and safely (e.g., using pallets and spacing between stacks) and preventing wood deformation due to pressure and moisture.
6	PA6	ERP system integration between finance and production divisions	1080	This strategy is useful to help document material purchases and production planning can be accessed across divisions in *real-time* and prevent delays in material purchases due to budget miscommunication.
7	PA9	Technical training on raw material storage for warehouse staff	864	This strategy is useful to help warehouse staff understand how to arrange wood neatly and safely (e.g., using pallets and spacing between stacks) as well as preventing wood deformation due to pressure and moisture.
8	PA10	Creation of specific *job sheets* per product model	852	This strategy is useful for providing detailed guidance for operators to avoid confusion when switching product types and reduce errors due to different design interpretations.
9	PA4	Warehouse layout and storage ventilation rearrangement	810	This strategy is useful for keeping wood dry, not damp, and not exposed to direct sunlight, its function is to prevent raw materials from deformation such as warping or mold.
10	PA3	Calibrate measuring instruments and cut regularly	395	This strategy is useful for maintaining a calibrated cutting machine in ensuring that the cut is up to the size of the technical design and reducing internal errors caused by worn or imprecise tools.
11	PA7	Implementation of standardized QC inspection forms (*checklist*)	324	This strategy is useful to help check that all items inspected will be in accordance with standard parameters, independent of individual intuition so that it can reduce the chance of defective products passing.

Conclusion

Based on the results of data processing that has been carried out in this study, it can be concluded as follows: On the House of Risk Phase 1 found 11 risk causes (risk agent) priority is the inaccuracy of the operator/human error (A15), the wood used in the production process has a different thickness (A13), the wood material used is not according to the size (16), the storage does not meet the material standard (A10), and the lack of communication with the buyer regarding the demand order (A4), lack of coordination between the finance department and the production department (A1), different QC member capabilities (A18), unfavorable weather changes (A26), poor and non-standard storage techniques (A11), many variations of products worked on (A12), and the wood materials used have not dried completely (A14).

On the House of Risk Phase 2 that has been made is known to have 11 risk mitigation strategies that are priorities that focus on each cause of priority risk, namely periodic job training and job skills certification (PA1), monitoring Wood moisture content using tools Moisture Content Meter (PA8), the implementation of digital communication systems such as CRM or Google Form to update order (PA5), standardization of raw material specifications to supplier (PA2), mandatory water content test (MC) Test) before the wood is processed (PA11), ERP system integration between the finance and production divisions (PA6), technical training on raw material storage for warehouse staff (PA9), manufacturing job sheet specific per product model (PA10), warehouse layout and storage ventilation (PA4), routine calibration of measuring and cutting tools (PA3), and implementation of standardized QC inspection forms (checklist) (PA7). For practitioners, the results highlight the importance of employee training, standardized procedures, interdepartmental coordination, and the adoption of digital systems to strengthen supply chain resilience. This research contributes practically by offering tailored recommendations and theoretically by applying the House of Risk method to the upstream supply chain in the furniture industry—a relatively underexplored area. Future studies are encouraged to examine downstream risks, compare across various product lines or companies, assess the financial impact of risk mitigation actions, and integrate other analytical methods such as FMEA or

ISSN 2714-7444 (online), https://acopen.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

AHP to broaden the understanding of supply chain risk management.

Acknowledgements

The author would like to express sincere gratitude to PT XYZ for the opportunity and support provided throughout the data collection and research process. Appreciation is also extended to all staff members in the purchasing, production, warehouse, and quality control departments for their cooperation and the valuable information shared. The author is also thankful to all other individuals who contributed directly or indirectly to the successful completion of this research

References

1. N. O. Baycik and S. Gowda, "Digitalization of Operations and Supply Chains: Insights from Survey and Case Studies," in Digital Transformation and Society, Elsevier, 2023, pp. 277–295.
2. T. Widiandaru and N. Imaningsih, "Analysis of Indonesian Furniture Production, Exchange Rates, and U.S. Per Capita Income on Indonesian Furniture Exports to the United States," JEMSI: Journal of Economics, Management, and Accounting, vol. 9, no. 3, pp. 1808–1812, 2023.
3. F. L. Wachadah, M. A. S. Izza, and M. Yasin, "Analysis of Industrialization Strategies in the Furniture Industry in Bukir Village, Gadingrejo District, Pasuruan City, East Java," Journal of Economics, Accounting, and Management, vol. 5, no. 2, pp. 82–93, 2023.
4. D. A. Krisprimandoyo, Principles and Strategies of Marketing. Yogyakarta, Indonesia: Deepublish Budi Utama, 2024.
5. B. Prasetyo, W. E. Y. Retnani, and N. L. M. Ifadah, "Supply Chain Risk Mitigation Strategy Analysis Using the House of Risk Method," Jurnal Tekno Kompak, vol. 16, no. 1, pp. 72–84, 2022.
6. M. Rivaldi and S. P. Caesar, "Supply Chain Analysis of Super Afifah Tofu in Nunu Village, Tatanga District, Palu City," Indonesian Journal of Management and Business, vol. 4, no. 1, pp. 13–20, 2025.
7. M. Y. Fathoni and S. Wijayanto, "Forecasting LPG Gas Sales in Grocery Stores Using the Fuzzy Time Series Method," Jurnal Jupiter, vol. 13, no. 2, pp. 87–97, 2021.
8. D. Hertina, L. Afiati, M. Munizu, S. Riyadi, J. R. Thamrin, and D. A. Irawan, Supply Chain Management: MRP Effectiveness in Achieving Business Success. Jakarta, Indonesia: PT Sonpedia Publishing Indonesia, 2023.
9. M. Aldi, M. T. Hasan, and Y. Nadya, "Supply Chain Risk Analysis of Fishery Products in Langsa City Using the House of Risk Method," Jurnal Teknik Industri, vol. 10, no. 1, pp. 39–53, 2020.
10. S. A. Maharani, S. Sari, M. As'adi, and A. P. Saputro, "Risk Analysis in Residential Construction Projects Using the House of Risk Method (Case Study: PT ABC)," Journal of Integrated System, vol. 5, no. 1, pp. 16–26, 2022.
11. T. P. Adhiana and A. A. Sibarani, "Determination of Risk Mitigation in Manufacturing SME Supply Chains," Journal of Management and Industrial Engineering–Production, vol. 7, no. 1, pp. 19–28, 2020.
12. M. Aldi, M. T. Hasan, and Y. Nadya, "Supply Chain Risk Analysis of Fishery Products in Langsa City Using the House of Risk Method," Jurnal Teknik Industri, vol. 10, no. 1, pp. 39–53, 2020.
13. A. Syamil et al., Supply Chain Management Textbook. Jakarta, Indonesia: PT Sonpedia Publishing Indonesia, 2023.
14. A. Ridwan, P. F. Ferdinant, and W. Ekasari, "Supply Chain Risk Mitigation Design for Pallet and Dunnage Products Using the House of Risk Method," TEKNIKA: Journal of Science and Technology, vol. 9, no. 1, pp. 35–44, 2020.
15. M. Rozudin and N. A. Mahbubah, "Implementation of the House of Risk Method in Green Supply Chain Risk Management of S2HD9C Bogie Products (Case Study: PT Barata Indonesia)," JISI: Journal of Industrial System Integration, vol. 6, no. 1, pp. 1–11, 2021.
16. F. A. F. Sitohang, A. Profita, and D. Widada, "Development Analysis of Mitigation Strategies for Log Wood Supply Chain Risks (Case Study: PT SLJ Global Tbk, Samarinda)," PROFISIENSI: Journal of Industrial Engineering Program, vol. 10, no. 2, pp. 128–140, 2022.
17. H. C. Wahyuni, I. A. Saidi, and W. Sumarmi, Risk Analysis in Supply Chains: A Focus on Food Safety Risk Research. Sidoarjo, Indonesia: Umsida Press, 2019.

ISSN 2714-7444 (online), https://acopen.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo